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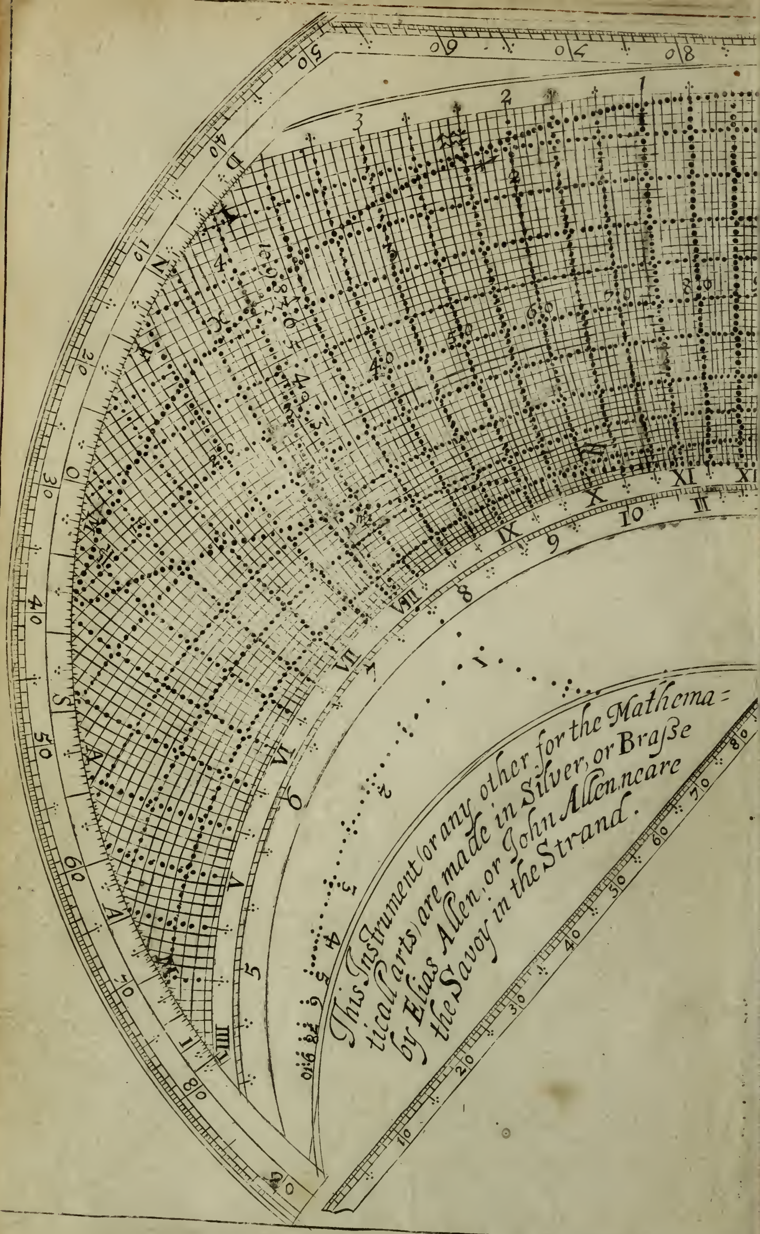
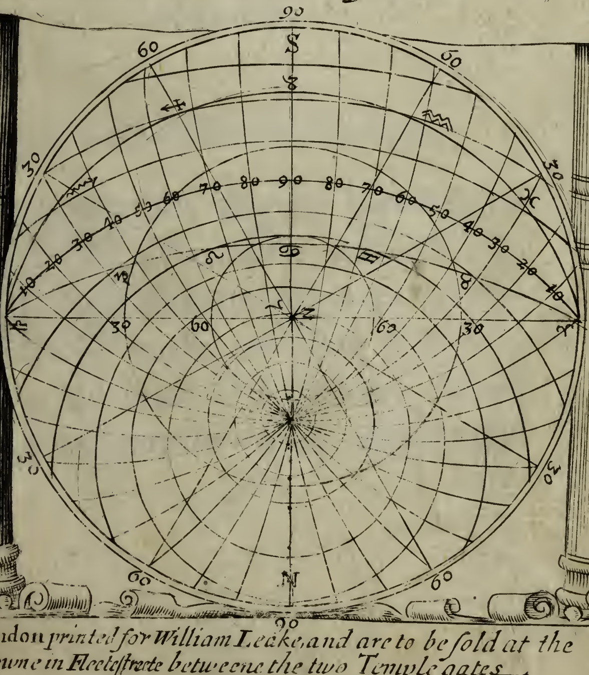

This Instrument (or any other for the Mathematical Parts) are made in Silver, or Braſse by Elias Allen, or John Allen neare the Savoy in the Strand.

# THE
# making, deſcription, and vſe of a ſmall portable Inſtrument for the pocket (or according to any Magnitude) in forme of a mixt Trapezia thus Called a Horizontall Quadrant.

Compoſed and produſed soly for the benefit, & vſe of such as are studious of Mathematicall Practice.
(Written and delivered by Delamain Student, and Teacher of the Mathematickes.

*Attribuit nullo praſcripto tempore vitæ*
*(Vsuram nobis ingenijque Deus.*



London printed for William Leake, and are to be ſold at the
Crowne in Fleetſtreete betweene the two Temple gates

Josiah H. Benton Fd.
Jan. 29, 1941
H

# TO
# The right Honorable
## and his much honoured Lo.
## *Thomas* Lo. *Brudenel,* Baron
## of *Stauton.*

*Right honourable, and my very good Lo.*

YOur *ſingular knowledge in all excellent, and ſolid* Literature, *and your ever* Heroicke, *and* Noble *diſpoſition to the beſt kinds of* Learning, *are not unknowne unto the world; And amongſt* *other ſtudies in your Lo. minoritie at the* Vniverſitie,*you tooke no little affection, to the* Mathematicall Arts, *as by your Lo. owne* Manu-ſcripts *and excellent* Bookes *in your Lo great* Librarie *J have often ſeene; Beſides, not onely by mine owne ſundry conferences with your Lo. but alſo by the relation of others of more mature judgement I have bin amply informed in theſe your L. more aged yeares not onely of your continued love to theſe* Arts,*but alſo that your knowledge in them far exceedes many of the* Nobilitie *of this* kingdome. *Now my L. when I cauſed the ſubject of this* Tractat *to be made for your Lo. laſt* Summer (*I meane your Lo.* Horizontall Quadrant) *J had not then any intention ſo ſoone to have written publikely upon it; But, having then but declared unto your Lo. the excellent and abundant uſe of the* Inſtrument *by the heads of the* propoſitions *then ſlightly compiled, (farre exceeding the* Inſtrumentall *Way in this nature, that eyther* Nobilitie,Gentrie, *or others are now acquainted with in this* kingdome, *for a recreative* Inſtrument, *as well for the copious uſe thereof, as its great facilitie,and expedition in operation)your Lo. then incouraging me to the publiſhing of it for a generall end; many* Moneths *after I conſidered thereon: and drew it up into a* Body,*and thus accommodated it, as I here preſent it now unto your Lo.favourable cenſure, and* Patronage*(to be ſheltred under the wings of your Lo. clemency againſt all calumniators and malevolents) as belonging eſpecially to your Lo. ſith you were the ſole motive to this worke, and had both the uſe of the* Inſtrument *before it came* *thus to a publicke view, and the firſt* Quadrant *that ever was made common in this kind: accept therefore favourably J beſeech your Lo. this ſmall mite of my labours, as from the hands of one of your pooreſt* ſervants *(yet true affectionate) who ſhall alwayes acknowledge your Lo: Nobleneſſe towards him, and ever reſt*

*Your Lo.*

*moſt humbly devoted*

*to Honour and*

*ſerve you*

*De la main.*

# To the Reader.

BEfore I ſhew the *Projection*, deſcribe the particulars, and deliver the uſes of this *Horizontall Quadrant*, it will not bee impertinent, for the ſatisfaction of ſome, to give the *Reader* to underſtand what moved me unto it, how it exceeds other *Inſtruments*, and whence it might be drawne, and projected.

*Now* the ingenious aptneſſe for *Inuention*, and accomodating of things in a faire and expedite courſe for *Mathmaticall Practices*, of that late profeſſor of *Aſtronomy* Mr. *Gunter* is not unknowne unto many about this kingdome, ſatisfying many of his friends (according to his free and noble affection) by *Tranſcripts* in that of more ſolid matter, but ſuch of vulgar *Practices* he hath publikely made manifeſt for the uſe of all ſuch as affect thoſe *Studies*. *In* which worke many yeares paſt I tooke occaſion to conſider the *Scheme*, or *Diagramme* of the fourth *Projection* in his *Booke* of the *Sector* Page the 64.& 65.w$^{ch}$ according as he ſaies is after the manner of the old *Concave hemiſphere*( but being in truth a naturall *Projection* of the viſible *Hemiſphere*, that is,one Moytie of the *Globe*, projected on a *Plaine*) which *Diagram* and *Projection* is now chalenged by my Reverend good friend *Maſter Oughtred*, and it ſhould ſeeme that *Maſter Gunter* had the Original of it from his labours,& invention,who compoſed and made the ſame ſo,for more then thirty yeares paſt, as appeares by his owne *Writings*,& *Manuſcripts* upon that *Projection* ſhewen me in the time of the Printing of this *Tractat* upon my *Horizontall Quadrant*, whoſe excellent knowledge in *Mathematicall* Learning may evidently confirme it : which *Projection* the ſaid *Maſter Oughtred* gave to the late *Biſhop* of *Wincheſter*, *Doctor Bilſon*,for more then 20. yeares paſt, and to ſome others of very good quality.

And it may alſo by a Letter from that moſt famous and admired *Geometer*, *Maſter Henry Brigges* unto *Maſter Oughtred* dated from *Greſham College Iune*, the 2. *Anno*,1618.be collected that the ſaid *Maſter Gunter* had the firſt overture of that fourth *Projection*, from the ſaid *Maſter Oughtred*,in which *letter* are theſe words:*Maſter Gunter* doth here ſend you the *Print* of an *Horizontall Diall* of his drawing after your *Inſtrument*; And afterwards the ſaid *Projection* was alſo preſented by *Maſter Gunter* to many Noble *Perſonages*, and in particular to the *Right Honourable* the *Earle* of *Bridgewater*, cauſing it to be cut in *Braſſe*, in ſuch a forme as I have placed at the end of this *Tractat*, ſome uſes of which *Diall* are extant, viz. the 2. 18 21. and 34. *Pro.* of the *Index* or *Table* following.

*Now* having conſidered diverſe *Pocket Inſtruments* (that many men are practiſed in) & looked into ſundry *Projections*, amongſt which that of *Gemmafriſius* (there drawne in the *Booke* of the *Sector*) is of admirable uſe, yet making a more ſerious quære, & contemplating more intenſively upon that *Diagram*, drawne and ſpecified in that 64. and 65. Pages of the *Sector* (aforeſaid) I found it farre to exceede all others in the *Multiplicity*, and excellencie of performance.

*If* I ſhould adde unto it a *Kalender* of *time*, and an *Index* graduated with an *Axis*, and *Perpendiculars* to be erected vpon it at pleaſure: & referring only the *Trapeziall forme*, it ſhould be fitted farre to exceede any portable *Inſtrument* for the *Pocket*, ever yet produced in reſpect of the general uſes of it: in reſolving ſuch ordinary *Propoſitions* which are practiced in *Aſtronomie*, upon the *Globe*, *Spheare*, *Hemiſpheare*, *Quadrants* of all ſorts, *Aſtrolabe* of *Friſius*, *Blagraue*; and others for facility, expedition, or certaintie, (like *Magnitudes* conſidered) for in theſe *Inſtruments* for ſeverall times, and ſeverall *Propoſitions*, there muſt be diverſe rectifications of the parts belonging to theſe *Inſtruments*, and that diverſly by reaſon of their diverſity:By this *Horizontall Quadrant*,the former rectifications are avoided,Contemplation & the eye being only the *Index*,the aptneſſe,& fitneſſe of the parts, and lines ſo naturally projected, or deſcribed as they are upon the plaine of the *Inſtrument*(being a part of the *Horizon* the *Parallels Meridians*, & *Verticall Circles*,that are contained or may be deſcribed in our *Latitude* ſufficiently neceſſary )induceth any one in the underſtanding of the uſes of it that is but indifferently verſed in the linaments and principles of the *Globe*,what to ſpeake, and what to anſwere in a *Propoſition* without farther direction : And having had this *Horizontall Quadrant* for many yeares paſt, as a *Pocket Inſtrument*,diverſe about this *Kingdome* being importunate with me for to have it, or to publiſh the uſe of it, ſeeing its great facilitie, and expedition,in compariſon of ſuch *Pocket Inſtruments* as are now uſed,here,or in forraigne parts: I was willing at laſt after I had given order for the making of fower of theſe *Inſtruments* in *Silver* for ſeverall *Noble Perſonages*, to disburthen my ſelfe of *Tranſcribing* the uſes of the *Inſtrument*,and *Tables* for the making of it, to ſatiſfie thoſe which were importunate, and to let others that are ſtudious in *Mathematicall Practices* alſo participate of it.

Now , what I have delivered vpon the accommodating of the *Inſtrument* thus, the making thereof, with the uſes that I have delivered in this *Tractat* upou it following : I acknowledge due to none *Inferiour aſſiſtant*, but to mine owne *Indnſtry*, *ſearch* and *labour*, and that 64. 65. and 66. *Pages* of the *Booke*: of the *Sector* before ſpecified in which is onely ſhewne the 2.3.19.22.25.and 30. *Propoſitions* of the *Index*,or *Table* following,as uſes of the ſaid *Projection.*

*But* I have extended them to many more, and abundantly, and plentifully ſupplied the obſcuritie of that *Scheme*, or *Diagramme* there drawne (as for a generall good) in the uſe of this *Horizantal Quadrant.* I deliver therfore firſt the making of it, firſt by the *Sector* (ſomewhat different from that of *Maſter Gunters*) ſecondly by *Geometrie*,and laſtly I ſhew a third way,how it may be *Proiected* and made by my *Mathematicall Ring*, and by *Numbers*, which I have *Calculated* and accommodated to that end in *Tables*, for more exactneſſe. *Part* of the generall ſcope,and uſe of which *Inſtrument* I deliuer in the *Index*,or *Table* following.

# *An Index, or Table of the vſes of the Horizontall Quadrant.*

Viz of the
- *Horizon.*
- *Line of Shadowes.*
- *Kalender.*
- *Parallels.*
- *Æquator.*
- *Eclipticke.*
- *Houre-lines.*
- *Index.*

1 *By the Horizon to ſhew.*

1. The *Sunne*, or *Starres Altitude* at any time. Pag. 53.
2. At any *Day* of the *yeare*, how farre the *Sun riſeth*, or *ſetteth* from the true *Eaſt* or *Weſt*. Pag. 28.
3. The *Suns Azimuth*, and *Altitude*, at any *houre*, for any *day*, Pag. 62.
4. The *Meridian* line, upon any appearance of the *Sunne*. Pag. 55.
5. The vncertaintie of *time*, by noting the *Shadow* of things, Pag. 63.
6. The *Site* of a *Building*, or Coſting of a *Place*. Pag. 57.
7. The *Variation* of the *Needle*. Pag. 59.
8. The *Declination* of a *Wall*, or *Plaine*, the *Sunne* ſhining thereon, Pag. 71.
9. The *Inclination* of a *Plaine*, and to place a *Plaine Horizontall*, Pag. 89.

10. At

2. *By the line of ſhadowes is had.*

10. At what *houre* in any *Day* of the *yeare* the *ſhadow* of an *Altitude* is equall, double, triple, &c. unto it. Pag. 35.
11. Inſtantly the *houre* of the *day*, the *Azimuth* and *Altitude* of the *Sun*, with the *Meridian line*, without obſervation or ſight of the *Sun*, by knowing the *Proportion* betweene the length of a *ſhadow* upon a *Horizontall Plaine* & that which caſts the *ſhadow*. Pag. 67.
12. At any *houre*, an *Altitude* of the *Sun*, or *Azimuth*, what Proportion *ſhadowes* have to their *Bodies*. Pag. 37.
13. Whether and *Altitude* be above, or below the levell of the *eye*, & how much.
14. The hight of an *Altitude*, acceſſible, or in acceſſible. Pag. 100. 101.
15. The meaſure of any Part of *Altitude* not approchable. Pag. 102.

3. *By the Kalender is knowne.*

16. The inequality of *Time*, in equall *Months*, or equall number of *Dayes* Pag. 44.
17. What number of *dayes* wil make the *day* and *houre* longer, or ſhorter at any time. Pag. 43.
18. The *houre* of the *Sun riſing*, *ſetting*, with the length of the *day at any time*, Pag. 23.
19. What *dayes* are alike in length, & what *day* the *Sun riſing* in the one, ſhall be the *Sun ſetting* in the other, Pag. 24.
20. The inequality of *Time* between day breake, and *Sun riſing*. Pag. 41.

4. *By the Parallels to ſearch out.*

21. At any day the *Suns declination*. Pag. 24
22. The *Latitude* of a *Place*, or hight of the *Pole* above the *Horizon*, Pag. 60.
23. At what *houre* in any *day*, the *Suns Azimuth*, and *Altitude* will be equall, and how much the *Altitude* & *Azimuth* wil be. Pag. 42

24. The

5. *By the Æquator is ſeene*

24. The *Suns* equall motion, *right Aſcention*, and *obliq; Aſcention*, Pag. 26.

6. *By the Eclipticke to give*

25. The *Sunnes Place* at any time of the yeare, Pag. 25.

26. The Degree of the *Æquator* in the *Horizon*, by ſuppoſing the degree of the *Eclipticke* in the *Horizon*, Pag 46.

27. The Degree of the *Eclipticke* in the *Horizon*, by ſuppoſing the degree of the *Æquator* in the *Horizon*. Pag. 47.

28. The degree of *Medium Cæli*, or the degree of the *Eclipticke* in the *Meridian*, by ſuppoſing the degree of the *Eclipticke* in the *Horizon*, *Vel* contra. Pag. 47.

29. The *Horoſcope*, or the degree *aſcendant*, or *deſcendant*, and the *Nonageſſima* degree at any *houre*. Pag. 49.

30. What Angle the *Eclipticke* makes with the *Horizon*, or the *Altitude* of the *Nonageſſima* degree and what *Azimuth* it is in at any *houre*, Pag. 50.

7. *By the hour lines to find*

31. The *houre* of the *Day*, and *Azimuth* of the *Sunne*, Pag. 54.

32. The *houre* of the *day* agreeable to any *Altitude*, or *Azimuth*, Pag. 39.

33. The *Sunnes* Difference of *Aſcention* for any *day*, Pag. 23.

34. The *Quarter* of the *yeare*, and *day* of the *moneth*, *houre* of the *day*, *Meridian-line*, and *Azimuth* of the *Sunne*, if it were forgotten: Pag. 64.

35. At

8. *By the Index adioyned with other lines you have.*

35. At what *houre*, & *Altitude*, the *Sun* wil be due *East*, at any *day* of the *yeare*, Pag. 27.
36. The *Suns Azimuth*, & *houre* without obſervation, Pag. 58.
37. The time of *day-breake*, or end of *Twi-light*, for any *day* in the *yeare*, Pag. 30.
38. The *hight* or *Depreſſion* of the *Sun* in the *Meridian*; for any *day* in the *yeare*, here or for any *Latitude*, Pag. 29.
39. The *Suns depreſſion* & *Azimuth*, at any *houre* of the *Night* aſſigned, Pag. 40.
40. The *houre* of the *day* to our *Antipodes*, by ſuppoſing the *ſuns depreſſion* under the *Horizon*, Pag. 42.
41. What *houre*, & *Altitude* the *ſunne* commeth upon a *declining wall*, any *day* in the *yeare*, & how long the *ſun* ſhineth thereon, Pag. 32.
42. At what *houre* and *Altitude* the *Sun* muſt have, to be oppoſite or Perpendicular to a *Declination Plaine*, Pag. 33.
43 The *declinatiō* of *a wall*, by ſeing the *ſun* beginning to ſhine thereon, or going from it, Pag. 69.
44. The *houre* & *Altitude* of a *ſtars* comingto the *Meridian* at any *Night* in the *yeare* aſſigned, Pag. 74.
45. The time of the *riſing*, *ſetting*, & continuance of a ſtarre above the *Horizon*, & in what part of the *Hemiſphere* they may be ſeene, with the *Azimuth* and *Altitude* thereof at any *houre*, Pag. 78.
46 In what part of the *Horizon* a *ſtarre riſeth or ſetteth*, and at what *houre* & *Altitude* it will be due *Eaſt* or *Weſt*, Pag. 80.
47. What *Azimuth* any *ſtarre* is in, upon any appearance thereof, with the *houre* of the *night*, Pag. 82.
48. How to meaſure the Quantitie of an *Angle*, or to finde the diſtance of two *Starres*, Pag. 85.
49. How to meaſure *Diſtances*, and *Bredths*, Pag. 87.
50. How to take the *Circuit* of a *Figure*, or the *ſurveigh* of a *Place*. Pag. 93.

MVch more I might have laid open upon the uſe of this *Inſtrument*, as the making of *Horizontall*, *direct*, *declining*, *cilindrical*, & *Ring dyalls*, the diſtance of the *houres*, *ſubſtiler* & *ſtiles* hight, *Stoflerius Aſtrolabe*, *Maſter Gunters Quadrant*, with many other *Inſtruments*, now uſed, but let theſe be ſufficient for the preſent; the ingenious, may eaſily adde vnto that which I have delivered, & therefore I ſhew firſt how to project the *Inſtruments*, then the *Deſcription*, and laſtly how theſe uſes, are compendiouſly contracted, and operated.

# The Tables for making of the Horizontall Quadrant.

## The Table for the deſcribing of the Parallels.

| G | A | B | C | F | E | D |
|---|---|---|---|---|---|---|
| 58 20 | ♑ | 37 30 | 76732 | 162173 | 401078 | 70 00 |
| 57 49 | 23 | 37 15 | 76041 | 158854 | 393750 | 75 45 |
| 56 45 | 22 | 36 45 | 74673 | 152576 | 379826 | 75 15 |
| 55 44 | 21 | 36 15 | 73323 | 146736 | 366795 | 74 45 |
| 54 42 | 20 | 35 45 | 71989 | 141292 | 354573 | 74 15 |
| 53 43 | 19 | 35 15 | 76673 | 136205 | 343084 | 73 45 |
| 52 41 | 18 | 34 45 | 59372 | 131445 | 332263 | 73 15 |
| 51 46 | 17 | 34 15 | 58087 | 126982 | 322052 | 72 45 |
| 50 50 | 16 | 33 45 | 56817 | 122791 | 312399 | 72 15 |
| 49 55 | 15 | 33 15 | 55562 | 118848 | 303259 | 71 45 |
| 49 01 | 14 | 32 45 | 54322 | 115134 | 294590 | 71 15 |
| 48 09 | 13 | 32 15 | 53095 | 111630 | 286356 | 70 45 |
| 47 17 | 12 | 31 45 | 51881 | 108321 | 278523 | 70 15 |
| 46 28 | 11 | 31 15 | 50681 | 105190 | 271061 | 69 45 |
| 45 38 | 10 | 30 45 | 59493 | 102226 | 263945 | 69 15 |
| 44 50 | 9 | 30 15 | 58318 | 99415 | 257149 | 68 45 |
| 44 03 | 8 | 29 45 | 57154 | 96748 | 250651 | 68 15 |
| 43 18 | 7 | 29 15 | 56002 | 94215 | 244432 | 67 45 |
| 42 34 | 6 | 28 45 | 54861 | 91805 | 238472 | 67 15 |
| 41 50 | 5 | 28 15 | 53731 | 89512 | 232756 | 66 45 |
| 41 08 | 4 | 27 45 | 52612 | 87327 | 227267 | 66 15 |
| 40 27 | 3 | 27 15 | 51503 | 85244 | 221991 | 65 45 |
| 39 47 | 2 | 26 45 | 50404 | 83256 | 216916 | 65 15 |
| 39 08 | 1 | 26 15 | 49314 | 81358 | 212030 | 64 45 |
| 38 29 | 0 | 25 45 | 48234 | 79498 | 207231 | 64 15 |
| 37 53 | 1 | 25 15 | 47163 | 77808 | 202719 | 63 45 |
| 37 17 | 2 | 24 45 | 46100 | 76148 | 198396 | 63 15 |
| 36 43 | 3 | 24 15 | 45046 | 74558 | 194162 | 62 45 |
| 36 08 | 4 | 23 45 | 44001 | 73033 | 190068 | 62 15 |
| 35 36 | 5 | 23 15 | 42963 | 71573 | 186109 | 61 45 |
| 35 03 | 6 | 22 45 | 41933 | 70171 | 182275 | 61 15 |
| 34 33 | 7 | 22 15 | 40911 | 68825 | 178562 | 60 45 |
| 34 02 | 8 | 21 45 | 39895 | 67538 | 174963 | 60 15 |
| 33 32 | 9 | 21 15 | 38887 | 66292 | 171472 | 59 45 |
| 33 03 | 10 | 20 45 | 37886 | 65099 | 168084 | 59 15 |
| 32 30 | 11 | 20 15 | 36891 | 63951 | 164994 | 58 45 |
| 32 08 | 12 | 19 45 | 35903 | 62847 | 161598 | 58 15 |
| 31 42 | 13 | 19 15 | 34921 | 61784 | 158490 | 57 54 |
| 31 17 | 14 | 18 45 | 33945 | 60761 | 155467 | 57 15 |
| 30 52 | 15 | 18 15 | 32975 | 59775 | 152525 | 56 45 |
| 30 28 | 16 | 17 45 | 32010 | 58825 | 149660 | 56 15 |
| 30 05 | 17 | 17 15 | 31050 | 57909 | 146869 | 55 45 |
| 29 42 | 18 | 16 45 | 30096 | 57026 | 144149 | 55 15 |
| 29 19 | 19 | 16 15 | 29147 | 56174 | 141496 | 54 45 |
| 28 50 | 20 | 15 45 | 28202 | 55353 | 138903 | 54 15 |
| 28 36 | 21 | 15 15 | 27263 | 54559 | 136382 | 53 45 |
| 28 16 | 22 | 14 45 | 26327 | 53794 | 133916 | 53 15 |
| 27 57 | 23 | 14 15 | 25396 | 53055 | 131506 | 52 45 |
| 27 47 | ♋ | 14 00 | 24932 | 52695 | 130522 | 52 30 |

K

## The Table for puting on the Kalander in the Horizon.

|  | I | F | M | A | M | I | I | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 36 37 | 22 40 | 5 41 | 13 41 | 29 40 | 39 12 | 37 20 | 25 08 | 7 19 | 11 27 | 29 00 | 39 04 |
| 2 | 36 19 | 22 07 | 5 02 | 14 17 | 30 13 | 39 19 | 37 05 | 24 37 | 6 42 | 12 05 | 29 28 | 39 13 |
| 3 | 35 58 | 21 33 | 4 24 | 14 53 | 30 39 | 39 21 | 36 49 | 24 05 | 6 05 | 12 42 | 29 58 | 39 23 |
| 4 | 35 38 | 20 58 | 3 46 | 15 29 | 31 04 | 39 33 | 36 32 | 23 34 | 5 28 | 13 24 | 30 24 | 39 29 |
| 5 | 35 20 | 20 24 | 3 08 | 16 01 | 31 31 | 39 38 | 36 15 | 23 02 | 4 51 | 13 59 | 30 53 | 39 35 |
| 6 | 34 58 | 19 49 | 2 31 | 16 36 | 31 54 | 39 42 | 35 57 | 22 30 | 4 14 | 14 34 | 31 19 | 39 40 |
| 7 | 34 36 | 19 14 | 1 53 | 17 12 | 32 18 | 39 46 | 35 39 | 21 58 | 3 35 | 15 07 | 31 47 | 39 44 |
| 8 | 34 14 | 18 39 | 1 14 | 17 48 | 32 43 | 39 48 | 35 20 | 21 26 | 2 58 | 15 44 | 32 11 | 39 48 |
| 9 | 33 50 | 18 02 | 0 37 | 18 23 | 33 05 | 39 50 | 35 00 | 20 52 | 2 20 | 16 20 | 32 36 | 39 50 |
| 10 | 33 27 | 17 28 | 0 02 | 18 57 | 33 29 | 39 52 | 34 39 | 20 23 | 1 43 | 16 56 | 33 02 | 39 52 |
| 11 | 33 03 | 16 51 | 0 40 | 19 31 | 33 50 | 39 52 | 34 20 | 19 45 | 1 06 | 17 31 | 33 27 | 39 53 |
| 12 | 32 38 | 16 15 | 1 18 | 20 04 | 34 12 | 39 51 | 34 00 | 19 12 | 0 28 | 18 07 | 33 57 | 39 52 |
| 13 | 32 13 | 15 39 | 1 56 | 20 37 | 34 33 | 39 51 | 33 36 | 18 39 | 0 10 | 18 43 | 34 12 | 39 50 |
| 14 | 31 47 | 15 03 | 2 34 | 21 11 | 34 54 | 39 50 | 33 08 | 18 04 | 0 48 | 19 17 | 34 36 | 39 48 |
| 15 | 31 19 | 14 25 | 3 11 | 21 45 | 35 14 | 39 46 | 32 51 | 17 31 | 1 25 | 19 52 | 34 58 | 39 44 |
| 16 | 30 53 | 13 49 | 3 50 | 22 17 | 35 34 | 39 42 | 32 26 | 16 57 | 2 04 | 20 28 | 35 18 | 39 40 |
| 17 | 30 26 | 13 12 | 4 27 | 22 49 | 35 53 | 39 39 | 32 02 | 16 32 | 2 41 | 21 01 | 35 39 | 39 35 |
| 18 | 29 58 | 12 36 | 5 06 | 23 21 | 36 12 | 39 35 | 31 37 | 15 46 | 3 19 | 21 35 | 35 59 | 39 30 |
| 19 | 29 28 | 11 58 | 5 44 | 23 53 | 36 28 | 39 29 | 31 13 | 15 07 | 3 56 | 22 08 | 36 17 | 39 25 |
| 20 | 29 00 | 11 20 | 6 20 | 24 24 | 36 45 | 39 21 | 30 48 | 14 28 | 4 35 | 22 44 | 36 36 | 39 17 |
| 21 | 28 29 | 10 43 | 6 59 | 24 54 | 37 00 | 39 13 | 30 21 | 14 01 | 5 12 | 23 16 | 36 53 | 39 08 |
| 22 | 28 00 | 10 06 | 7 35 | 25 25 | 37 17 | 39 06 | 29 54 | 13 25 | 5 50 | 23 50 | 37 11 | 38 58 |
| 23 | 27 29 | 9 29 | 8 12 | 25 56 | 37 31 | 38 58 | 29 28 | 12 48 | 6 28 | 24 22 | 37 26 | 38 49 |
| 24 | 27 00 | 8 50 | 8 50 | 26 25 | 37 45 | 38 47 | 29 00 | 12 13 | 7 06 | 24 55 | 37 41 | 38 37 |
| 25 | 26 29 | 8 12 | 9 27 | 26 56 | 37 57 | 38 37 | 28 32 | 11 37 | 7 44 | 25 27 | 37 56 | 38 26 |
| 26 | 25 56 | 7 35 | 10 03 | 27 26 | 38 11 | 38 26 | 28 04 | 11 01 | 8 20 | 25 58 | 38 09 | 38 13 |
| 27 | 25 25 | 6 57 | 10 40 | 27 58 | 38 22 | 38 15 | 27 36 | 10 24 | 8 58 | 26 29 | 38 23 | 38 00 |
| 28 | 24 53 | 6 20 | 11 16 | 28 24 | 38 34 | 38 02 | 27 07 | 9 26 | 9 35 | 27 00 | 38 33 | 37 47 |
| 29 | 24 21 |  | 11 53 | 28 50 | 38 45 | 37 49 | 26 38 | 9 10 | 10 14 | 27 29 | 38 45 | 37 32 |
| 30 | 23 46 |  | 12 29 | 29 17 | 38 55 | 37 36 | 26 08 | 8 33 | 10 49 | 28 00 | 38 56 | 37 15 |
| 31 | 23 13 |  | 13 07 |  | 39 04 |  | 25 37 | 7 57 |  | 38 30 |  | 36 56 |

S

## The Table for the inſerting and dividing the Line of Shadowes.

|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 45 00 | 42 00 | 39 49 | 37 34 | 35 32 | 33 41 | 32 00 | 30 28 | 29 03 | 27 46 |
| 2 | 26 33 | 25 28 | 24 27 | 23 30 | 22 37 | 21 48 | 21 20 | 20 19 | 19 39 | 19 02 |
| 3 | 18 26 | 17 53 | 17 21 | 16 51 | 16 23 | 15 57 | 15 31 | 15 07 | 14 45 | 14 23 |
| 4 | 14 02 | 13 43 | 13 23 | 13 06 | 12 48 | 12 32 | 12 16 | 12 00 | 11 46 | 11 32 |
| 5 | 11 19 | 11 06 | 10 53 | 10 41 | 10 30 | 10 18 | 10 07 | 9 57 | 9 47 | 9 37 |
| 6 | 9 27 | 9 19 | 9 10 | 9 01 | 8 53 | 8 45 | 8 37 | 8 29 | 8 22 | 8 15 |
| 7 | 8 07 | 8 01 | 7 54 | 7 48 | 7 42 | 7 35 | 7 30 | 7 24 | 7 18 | 7 13 |
| 8 | 7 07 | 7 02 | 6 58 | 6 52 | 6 47 | 6 42 | 6 38 | 6 33 | 6 29 | 6 24 |
| 9 | 6 20 | 6 16 | 6 12 | 6 08 | 6 04 | 6 01 | 5 57 | 5 53 | 5 49 | 5 46 |
| 10 | 5 43 |  |  |  |  |  |  |  |  |  |
| 15 | 3 49 |  |  |  |  |  |  |  |  |  |
| 20 | 2 51 |  |  |  |  |  |  |  |  |  |
| 40 | 1 26 |  |  |  |  |  |  |  |  |  |

## The Table for drawing the houre lines

| T. 125717 |  |  | P.34921 |  |  |
|---|---|---|---|---|---|
|  |  | H |  | I |  |
|  | 1 | 1745 | 46 | 103553 |  |
|  | 2 | 3492 | 47 | 107236 |  |
|  | 3 | 5240 | 48 | 111061 |  |
|  | 4 | 6992 | 49 | 115063 |  |
|  | 5 | 8748 | 50 | 119175 |  |
|  | 6 | 10510 | 51 | 123489 |  |
|  | 7 | 12278 | 52 | 127994 |  |
|  | 8 | 14054 | 53 | 132704 |  |
|  | 9 | 15838 | 54 | 137638 |  |
|  | 10 | 17632 | 55 | 142814 |  |
|  | 11 | 19438 | 56 | 148256 |  |
|  | 12 | 21255 | 57 | 153986 |  |
|  | 13 | 23086 | 58 | 160033 |  |
|  | 14 | 24932 | 59 | 166427 |  |
| 7 | 15 | 26794 | 60 | 173205 | 10 |
|  | 16 | 28674 | 61 | 180404 |  |
|  | 17 | 30573 | 62 | 188072 |  |
|  | 18 | 32491 | 63 | 196261 |  |
|  | 19 | 34432 | 64 | 205030 |  |
|  | 20 | 36397 | 65 | 214459 |  |
|  | 21 | 38386 | 66 | 224603 |  |
|  | 22 | 40402 | 67 | 235585 |  |
|  | 23 | 42447 | 68 | 247508 |  |
|  | 24 | 44522 | 69 | 260508 |  |
|  | 25 | 46630 | 70 | 274747 |  |
|  | 26 | 48775 | 71 | 290421 |  |
|  | 27 | 50952 | 72 | 307768 |  |
|  | 28 | 53170 | 73 | 327085 |  |
|  | 29 | 55430 | 74 | 348741 |  |
| 8 | 30 | 57735 | 75 | 373205 | 11 |
|  | 31 | 60086 | 76 | 401078 |  |
|  | 32 | 62486 | 77 | 433147 |  |
|  | 33 | 64940 | 78 | 470463 |  |
|  | 34 | 67450 | 79 | 514455 |  |
|  | 35 | 70020 | 80 | 567128 |  |
|  | 36 | 72654 | 81 | 631375 |  |
|  | 37 | 75355 | 82 | 711536 |  |
|  | 38 | 78128 | 83 | 814434 |  |
|  | 39 | 80978 | 84 | 951436 |  |
|  | 40 | 83909 | 85 | 1143005 |  |
|  | 41 | 86928 | 86 | 1430067 |  |
|  | 42 | 90040 | 87 | 1908114 |  |
|  | 43 | 93251 | 88 | 2863625 |  |
|  | 44 | 96568 | 89 | 5729869 |  |
| 9 | 45 | 100000 | 90 |  | 12 |

## The Table for drawing, and dividing the Eclipticke

| ♑. 26794. |  |  | ♋. 188072. |  |  |
|---|---|---|---|---|---|
| K | L | M | N | O | P |
| 1 | 0 55 | 2604 | 46 | 43 31 | 94951 |
| 2 | 1 50 | 3200 | 47 | 44 31 | 98326 |
| 3 | 2 45 | 4893 | 48 | 45 28 | 101642 |
| 4 | 3 40 | 6408 | 49 | 46 32 | 105500 |
| 5 | 4 35 | 8016 | 50 | 47 32 | 109258 |
| 6 | 5 31 | 9658 | 51 | 48 34 | 113294 |
| 7 | 6 25 | 11246 | 52 | 49 34 | 117361 |
| 8 | 7 21 | 12899 | 53 | 50 35 | 121669 |
| 9 | 8 10 | 14350 | 54 | 51 37 | 126244 |
| 10 | 9 12 | 16196 | 55 | 52 38 | 130952 |
| 11 | 10 07 | 17842 | 56 | 53 43 | 135967 |
| 12 | 11 03 | 19528 | 57 | 54 42 | 141235 |
| 13 | 11 57 | 21164 | 58 | 55 44 | 146777 |
| 14 | 12 53 | 22872 | 59 | 56 46 | 152822 |
| 15 | 13 48 | 24562 | 60 | 57 48 | 158797 |
| 16 | 14 42 | 26234 | 61 | 58 51 | 165445 |
| 17 | 15 40 | 28045 | 62 | 59 54 | 172509 |
| 18 | 16 36 | 29811 | 63 | 60 57 | 180034 |
| 19 | 17 31 | 31561 | 64 | 62 00 | 188072 |
| 20 | 18 28 | 33394 | 65 | 63 03 | 196685 |
| 21 | 19 24 | 35215 | 66 | 64 06 | 205941 |
| 22 | 20 20 | 37057 | 67 | 65 10 | 216089 |
| 23 | 21 16 | 38921 | 68 | 66 13 | 226909 |
| 24 | 22 12 | 40809 | 69 | 67 17 | 238862 |
| 25 | 23 09 | 42756 | 70 | 68 21 | 251928 |
| 26 | 24 06 | 44836 | 71 | 69 25 | 266280 |
| 27 | 25 03 | 46737 | 72 | 70 29 | 282130 |
| 28 | 26 00 | 48773 | 73 | 71 34 | 300028 |
| 29 | 26 57 | 50842 | 74 | 72 38 | 315752 |
| 30 | 27 54 | 52947 | 75 | 73 43 | 342342 |
| 31 | 28 51 | 55089 | 76 | 74 47 | 367638 |
| 32 | 29 49 | 57309 | 77 | 75 53 | 397637 |
| 33 | 30 46 | 59533 | 78 | 76 57 | 431429 |
| 34 | 31 44 | 61841 | 79 | 78 02 | 471812 |
| 35 | 32 42 | 64198 | 80 | 79 07 | 520107 |
| 36 | 33 40 | 66607 | 81 | 80 12 | 578938 |
| 37 | 34 39 | 79114 | 82 | 81 17 | 652233 |
| 38 | 35 37 | 61636 | 83 | 82 23 | 747805 |
| 39 | 36 36 | 74266 | 84 | 83 28 | 873171 |
| 40 | 37 35 | 76964 | 85 | 84 33 | 1048126 |
| 41 | 38 34 | 79733 | 86 | 85 38 | 1309576 |
| 42 | 39 33 | 82580 | 87 | 86 48 | 1761056 |
| 43 | 40 32 | 85508 | 88 | 87 49 | 2622964 |
| 44 | 41 32 | 88576 | 89 | 88 55 | 5288211 |
| 45 | 42 31 | 91686 | 90 | 90 00 |  |

## The Table for dividing the Index.

|  | Q |  | Q |
|---|---|---|---|
| 1 | 872 | 46 | 42447 |
| 2 | 1745 | 47 | 43481 |
| 3 | 2618 | 48 | 44522 |
| 4 | 3492 | 49 | 45572 |
| 5 | 4366 | 50 | 46630 |
| 6 | 5240 | 51 | 47697 |
| 7 | 6116 | 52 | 48773 |
| 8 | 6992 | 53 | 49858 |
| 9 | 7870 | 54 | 50952 |
| 10 | 8748 | 55 | 52056 |
| 11 | 9628 | 56 | 53170 |
| 12 | 10510 | 57 | 54295 |
| 13 | 11393 | 58 | 55430 |
| 14 | 12278 | 59 | 56577 |
| 15 | 13165 | 60 | 57735 |
| 16 | 14054 | 61 | 58904 |
| 17 | 14945 | 62 | 60086 |
| 18 | 15838 | 63 | 61280 |
| 19 | 16734 | 64 | 62486 |
| 20 | 17632 | 65 | 63707 |
| 21 | 18533 | 66 | 64940 |
| 22 | 19438 | 67 | 66188 |
| 23 | 20345 | 68 | 67450 |
| 24 | 21255 | 69 | 68728 |
| 25 | 22169 | 70 | 70020 |
| 26 | 23086 | 71 | 71329 |
| 27 | 24007 | 72 | 72654 |
| 28 | 24932 | 73 | 73996 |
| 29 | 25861 | 74 | 75355 |
| 30 | 26794 | 75 | 76732 |
| 31 | 27731 | 76 | 78128 |
| 32 | 28674 | 77 | 79543 |
| 33 | 29621 | 78 | 80978 |
| 34 | 30573 | 79 | 82433 |
| 35 | 31529 | 80 | 83909 |
| 36 | 32491 | 81 | 85408 |
| 37 | 33459 | 82 | 86928 |
| 38 | 34432 | 83 | 88472 |
| 39 | 35411 | 84 | 90040 |
| 40 | 36397 | 85 | 91633 |
| 41 | 37388 | 86 | 93151 |
| 42 | 38386 | 87 | 94896 |
| 43 | 39391 | 88 | 96568 |
| 44 | 40402 | 89 | 98269 |
| 45 | 41421 | 90 | 100000 |

# Of the Making of the Horizontall Quadrant by the *Sector.*

1. How to deſcribe the Parallels.

FIrſt, according to any *Semidiameter* as *ZN.* or *Z S.* deſcribe a Circle repreſenting the *Horizon,* and draw the line *S N.* for the *Meridian*: Divide the halfe *Meridian ZN.* and *Z S.* into 90.gr. according to the *Tangents* of halfe their Arkes, by the helpe of the *Sines* on the edge of the *Sector*: or the ſemidiameters may be divided into ſuch parts, or points as are required concerning the *Projection,* thus. Conſider what parallels you would deſcribe, and how much they are diſtant from the *Zenith* in their interſections, in the *Meridian* both towards the South and North of the *Zenith* (for every parallell in an oblique *Spheare,* in his interſection with the *Meridian,* is farther from the *Zenith* in one part, than in an other) Then if the ſemidiameter *Z N.* be placed over in the *ſigne Complement* of halfe that diſtance, from the Zenith, the parallell *Sine* of the former halfe taken from the *Sector*: ſhall from ſhew the interſection in the *Meridian* with that parallell.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| So if the paralles were the | *Tropicke* of ♋ | whoſe diſtances ef interſections in the Meridian (according to the Lat. of 51. gr. 30. m.) from Z. towards | S. the South | is | gr. m.<br>28. 0. | The halfe of theſe Arkes are | gr. m.<br>14.00.A |
| | | | N. the North | | 105.0, | | 52.30.B |
| | *Æqnator* | | S. the South | | 51·30. | | 25.45.C |
| | | | N. the North | | 128,30 | | 64.15.D |
| | *Tropicke* of ♑ | | S. the South | | 75 30. | | 37.30.E |
| | | | N the North | | 152.0. | | 76.00.F |

Now if the ſemidiameter *Z.S.* bee placed in the *Sine Complement* of A.viz. 76.gr. and then the parallell Sine of A taken,viz.14.gr.it will reach from *Z.* to ♋. the interſection of the *Tropicke* of ♋ with the South part of the *Meridian,* but if the ſemidiameter *Z.S.* be placed over in the *Sine Complement.B.*viz.37.gr.30.m.& then the parallell Sine of *B.*viz.52.gr.30.m.being taken it will reach from *Z* to V.the other interſection of the *Tropicke* of 69 with the *Meridian* below the Pole, the Middle betweene this V.and 69. will bee at 1. which is the Center of that *Tropicke* : In like manner may be found the interſections and *Centers* of the other parallels with the *Meridians,*and ſo may be deſcribed.

2. To deſcribe the houre lines

*Secondly,*ſeeing the Lat.is 51.gr.30.take the Semidiameter *Z S.*and fit it over in the *Sine Complement* of it, viz. 38.gr.30. then the parallell ſine of 51.gr.30.m. will reach from *Z.* to *T.*the center of the houre of 6. *E P W* but if the *Radius Z S.* be fitted over in the *Sine Complement* of halfe 38.gr. 30.viz.70.gr.45.m. and the parallel ſine of halfe 38.gr.30.viz. 19.gr. 15.m.be taken, it will reach from *Z.*to *P.* the *Pole,*then upon *T.* erect a perpendicular to the line *P T.*viz.2. *T.*10. which ſhall ſerve for the finding of the Centers of the *Meridians,*or houre Circles paſſing through the *Pole P.* now ſeeing that *T P.*is the neereſt diſtance in the right line 2.10.unto *P.*the right line *P.T.*ſhall be *Radius,* to a Circle, and the line 2.*T.*10. ſhal be a Tangent line to that Circle.Now the *Radius* of a Circle being knowne,the Tangent of any Angle,or Arke, may be alſo knowne, according to the Naturall projection and congruity of lines,but becauſe in this firſt direction we would apply it ſoly to the *Sector* : the center of the *Meridians* or houres may be had by the helpe of the Sines thereon thus.

Conſider what houre, or *Meridian circle* from the houre of 6.viz. E,*P*,*W*. you would diſcribe,for then if the *Radius P,T.* be fitted over in the *Sine complement* of it and the parallell *Sine* of the houre Angle Taken, it will ſhew from *T*, in the line 2.10. the center of that *Meridian,*or houre circle : ſo if the houre circle of 5. or 7. were

to

o be deſcribed, whoſe houre Angle at *P*, the Pole is
5. gr. fit the *Radius* or ſemediameter *T*, *P*. over
n the Sine complement of it viz. 75.gr. for then the
ine perallell of 15.gr. being taken will reach from *T*,to
. and from *T*, to 7, the Center of the houre circles of 5
nd 7. If therefore one foote of the Cumpaſſes be placed
n 5.and then extended to *P*. the Pole, you may deſcribe
ne houre Circle of 5. and placed in 7. you may draw the
oure Circle of 7. and ſo may be deſcribed the reſt of the
*eridians* . and houre Circles.

3 To deſcribe and divide the Eclipticke

*Thirdly*, to deſcribe the *Eclipticke*, conſider the diſtan-
s betweene the *Zenith Z*.and the Tropicks of ♑. and ♋.
cording to the former Lat.of 51.gr.30. which will be *Z*,
♑ 75.gr.and *Z*. ♋.28.gr.then take the ſemideameter *Z*,*S*.
nd fit *it* over in the *Sine* of thoſe Arkes, then the par-
llell *Sines* of the Complements of thoſe Arkes will
ew from *Z*. the diſtances of the Centers of theſe Tro-
icall points, ſo the Center of the Southerne ſemicircle of
e *Eclipticke*, will be neare the Pole *P*,viz.at ♑. and
e Center of the Northerne ſemicircle of the *Eclipticke*
ill be below the Pole at ♋.Therefore placing one foote
f the Campaſſes in ♋. below the Pole, and extending
e other foote to ♋. above the *Pole* you may deſcribe the
micircle *E*,♋.*W*. and placing one foote in ♑. neare the
*ole*, you may deſcribe the ſemicircle,*E*,♑,*W*.

Now for the dividing of the *Eclipticke* ; this Mr. *Gun-*
*er* delivers ſo obſtruſly in his 66,page of the Sector.That
a man had not more fundamentall Mathematicall Do-
trine, then his Booke teacheth, he ſhould never attaine
nto it:Conſider therefore firſt,what right Angle Triangles
here are made by this *Eclipticke*,*Equator* and *Meridians*,
iz, ♈ B ♓. or ♈ *B* ♉: ♈ *R* ♒. or ♈ *R* ♊,&c. and
et the *right aſcention* of theſe Arkes of the *Eclipticke* hat
ou intend to divide, ſo ♈,*B*. is the *right aſcention* of the
rkes ♈,♉, and ♈,♓. and ♈, *R*.is the Right aſention of
rkes ♈, ♊, and ♈,♒, from which ground the Table *S*.
s calculated according to the Arkes in the *Eclipticke* in
he Table *R*. Now to finde the Centers of thoſe *Me-*
*idians* which may divide the *Eclipticke* according to the

*Right aſcenſion* here calculated anſwerable to the Arkes of the *Eclipticke* from ♈ or ♎ it nothing differeth from the inſtruction of the deſcribing of the houre Circles, in the ſecond derection : for if I would interſect the *Eclipticke* in the beginning of ♉.♓.♍.or ♏. the diſtance of either of thoſe ſinges from ♈ or ♎ is 30.gr.againſt which in the Table, *S.*is 27.gr.54.m. Now if the ſemidiamiter *P T.*be fitted over in the *ſine Complement* of this 27.gr.54.m.viz.68.gr.6.m.and then the parallell *ſine* of 27.gr.54.m.being taken it wil reach frō *T.*to 30.in the line 2. *T.*10. if therefore one foote of the Compaſſes bee placed in 30. towards 10. and the other foote extended to *P.* you may interſect the *Eclipticke* in ♉. and ♓. and then the Compaſſes placed in the other 30.you may interſect the other part of the *Eclipticke* in ♍ and ♏. and ſo may you divide the reſt of the *Eclipticke.*

| *R.* | *S.* |
|---|---|
| 5 | 4.45 |
| 10 | 9.11 |
| 15 | 13.48 |
| 20 | 18.27 |
| 25 | 23.09 |
| 30 | 27.54 |
| 35 | 32.42 |
| 40 | 37.35 |
| 45 | 42.31 |
| 50 | 47.33 |
| 55 | 52.38 |
| 60 | 57.48 |
| 65 | 63.03 |
| 70 | 68.21 |
| 75 | 73.43 |
| 80 | 79.07 |
| 85 | 84.32 |
| 90 | 90.00 |

# Of the making of the Horizontall Quadrant Geometrically.

1. FIrſt, having diſcribed a *Cirrle* at pleaſure as before, *E.S. W.N.* draw a line to paſſe by the center as *S.N.* and croſſe it at right Angles, with the line *E.W.*in *Z.* then let the *ſemcircles W S E* and *W N E.* bee divided from *W.* each of them into 180.gr.or rather upon *E.* wee may diſcribe a *Quadrant* at pleaſure, as *C D.* and augmenting it unto *ω*, divide the *Quadrant D C.* from *D.* into the uſuall diviſions of a *Quadrant*, and ſo from *D.* unto *ω*, inſert or protract the ſame diviſions, then having conſidered as be-

fore

1 To deſcribe the parallels.

fore the *Latitude* of the place,and diſtance of the parallels from *Z.* the *Zenith*,towards *S.*the *South*,and alſo towards *N.*the *North*, in the *Meridian* as in the former Table there is ſpecified. Account the diſtance of the parallels from the *Zenith* towards *S.* the *South*, in the ſemicircle *W S E.* but thoſe towards *N* the *North*,in the ſemicircle *W N E.*from *W.*ſo ſuppoſing the Latitude as before to bee 51.gr.30.m. the diſtance betweene the *Zenith* & the Tropicke of ♋.towards the *South*, is 28.gr. which account from *W.* to *F.* but rather halfe of it from *D.* to *F.* then conſider the diſtance betweene the Zenith and the other part beyond the *Pole*, viz.105. gr. number this from *W.* to *G.*but rather halfe uf it from *D.*to *G.* and laying a ruler upon *E.F.*and *E.G.* the *Meridian A B.* may be interſected in ♋. and *V.* the middle, betweene which will be at 1.the Center of the Tropicke: in like manner the diſtance of the *Æquator* from the Zenith towards the South is 51.gr 30. reckon it from *W.* to *H.* or halfe of it from *D.*to *H.* but the diſtance of the *Æquater* from the Zenith towards the *North* beyond the *Pole* is 128. gr. 30.m. which I account from *W.*to *I.*or halfe of it from *D.* to *I*, then laying a ruler upon *E.H.* and *E.I.* the *Meridian A B.*may be interſected in *Q* and *Y.* the halfe diſtance betweene *Q* and *Y.*will be at 2.the Center of the *Æquater*: In like manner may the *Meridian A B.* bee divided into any of the reſt of the diviſions,and the parallels alſo diſcribed:But if a ruler be faſtned to move upon *E.* then may you ſoftly move the ruler from *D.*towards *ω.*and as it paſſet by the degrees according to the Colume *B.* of the Tables following, beginnig at the bottome, ſo the edge of the ruler ſhall ſhew the interſections that the parallels of declination betweene the Tropickes do make,with the *Meridian Z. S.*then move the *Ruler* ſoftly along from *D.* towards *C.*as it paſſeth by the degrees in the Colume *G.*beginning at the bottome, ſo the edge of the *Ruler* ſhall interſect the *Meridian A.B.* in the Centers of thoſe parallels.

2. *Secoudly*,account the *Latitude* from *D* to *M.* and halfe the Complement of the Lat. from *D* to *R*, and laying a

ruler upon E *M*.and E *R*.the *Meridian, S N*. ſhall be interſected in *T*. and *P*. *P*.repreſenting the Pole of the 2 To deſcribe the houre lines world,and *T* the center of the houre of 6. then unto the line *T P*. upon the point *T*. erect a *perpendicular* 2. 10. and according to the ſemidiameter *P T*. deſcribe a ſemicircle *α T* 6. divide the *Quadrants T α* and *T* 6.from *T*. each of them into 90.gr.then lay a ruler upon *P*. and the ſeverall houre Arkes in the *Quadrants,T α*. and *T* 6. interſect the line 2.*T*.10.in the houre points, 2.3.4.5.7.8.9. 10.&c.then placing the Compaſſes in *T*. and extending the other foote to *P*. you may diſcribe the houre Circle of 6.but placing it in 5.and extended to *P*. you may diſcribe the houre Circle of 5.the ſame extent placed in 7.will diſcribe the houre Circle of 7.and ſo of the reſt: but if a ruler be faſtned to move on *P*. as it paſſeth by the degrees of the houres in the Quadrants from *T*. ſo the edge of the *Ruler* ſhall interſect the line 2.10. in the Centers of thoſe houres from *T*.

3. To deſcribe and divide the Eclipticke. *Thirdly*,to deſcribe the *Eclipticke*,conſider the Altitude of each Tropicke above the *Horizon*, according to the *Latitude* given,which was 51. gr.30.m.So the Altitude of ♑. is 15.gr.and that of ♋.is 62.gr.In the Quadrant *D C*.account thoſe degrees from *D*.viz.*D γ*.and *D δ*. lay a ruler upon E.and thoſe ſeverall points, ſo may the Meridian *S. N*.be interſected in the points ♑. and ♋. which are the Centers of the ſemicircles of the Eclipticke, therefore placing one foote of the Compaſſes in ♋.below the Pole, and extending the other foote to ♋. above the Pole, you may diſcribe the Northeren ſemicircle *E*.♋.*W*. and placing one foote of the Compaſſes in ♑.neere the Pole, and extending the other foote to ♑.neere *S*. you may deſcribe the *Southerne ſemicircle E* ♑ *W*. thoſe ſemicircles of the *Eclipticke* may bee divided *Geometrically*, without the helpe of the Table of *right aſcenſion*, but for more expedition we may uſe them thus. In the *Quadrants T α*. and *T* 6. account the degrees of the *right aſcenſion* for ſuch diviſions of the *Eclipticke* as you intend to have,ſuppoſe the beginning of ♉ ♓ or ♍ ♏ the diſtances of the beginning of any of theſe ſignes, from the *Equinoctiall* points are

equall the one unto the other.viz.30.gr which finde in the Table under *R*.ſo right againſt it under *S*.is 27.gr.54.m. this account from *T*. towards *a*. and *C*.and laying a ruler upon *P*.and thoſe degrees interſect the Tangent line 2.10. in 30.and then placing one foote of the Compaſſes in 30. towards 10.and extending the other foote to *P*.you may interſect the *Eclipticke* in the beginning of ♉.♓.&ſo in ♍ ♏.the points required: In the likemanner you may divide the other part of the *Eclipticke*.So the Centers of the degrees of the Eclipticke may bee ſooner had, if a ruler bee placed upon *P*.and then to move thereon, Now as it paſſeth by the degrees of the Columes *I.O*.in tha Tables following from *T*.in the ſeveral *Quadrants*:ſo the *Ruler* ſhall Interſect the line 2.10.in the Centers of thoſe Arkes anſwerable to the columes *K N*.the degrees of the Eclipticke.

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## 3. By my Ring it may bee otherwiſe projected: *In which it exceeds any Inſtrument whatſoever for facility, and expedition, for where there is many proportionals required in any ſervice, there the uſe of the Ring is moſt excellently made manifeſt, they being inſtantly declared at once, which in ſome ſort I have delivered in the uſe of my Appendix upon plaine Triangles, or it may be drawne from that of Proportionating the Fort, to the Fort, or the Building, to the Building, Pag. the 2.and 3.*

LEt a Circle bee diſcribed according to any capacity, as Conſtructi.
before, and croſſed with *diametrall lines* at right Angles

E.Z.

Of the calculating of the Numbers, to deſcribe the parallels.

*E Z W*.and *S Z N*.then take the ſemidiameter *E Z*. and divide it into 10.parts,& ſupdivide each of thoſe parts into 10.or 100.(according to the capacity of the ſcale)as *A*. or more accurately according to the ſame *Radius* make a *diagonall* ſcale, then conſider the diſtance of the *parallels* from the *Zenith* according to the *Latitude* you intend, as admit 51.gr.30.m.to be the *Latitude* as before. Take the halfe of thoſe diſtances (according to the firſt directions) by which is made the Colume *B*.which are the halfe diſtances of every degree betweene the *Tropickes* and the *Zenith*,then move the *Tangent* of 45.gr. unto the parts of the *Radius* or ſemidiameter, viz.10000. in the *Circle* of *Numbers*,ſo right againſt the Tangent of any one of thoſe degrees in the Colume *B*.in the moveable is the Number of equall parts in the fixed, by which is made the Colume *C*.(or they may be extracted out of the Tables of naturall *Tangents*.)Further if we conſider the diſtance betweene the *Zenith* and the other interſections of thoſe parallels, with the *Meridian* beyond the *Pole*,and take halfe of thoſe diſtances wee may make the Colume *D*.then moving the moveable ſoftly along,as the *Tangent* of any degree of the Colume *D*.in the moveable, paſſeth by the parts of the ſcall,viz.10000.in the fixed (on the Circle of *Numbers*) ſo the *Tangent* of 45.gr.in the moveable,ſhall point out in the Circle of *Numbers*,the diſtance betweene *Z*. and thoſe *parallels* beyond the *Pole*.From theſe directions are calculated the Numbers in the Colume *E*.or they may bee alſo taken from the Table of naturall *Tagents* as before : The Numbers of the Colume *C* and *E*.ſerve to finde the diſtances of the interſections of the *parallels* in the *Meridian* frõ *Z*.& to diſcribe thoſe parallels,note that at the bottome of the Columes *C*.& *E*.are the Numbers,2493.& 13032. take 2493. from the *diagonall ſcale*, and protract it from *Z*.towards *S*.viz.at ♋.then take from the ſame ſcale alſo, 13032.and protract it from *Z*. to ♋.below *N*. divide the ſpace betweene ♋. and ♋.. into two equall parts which will be at 1.neere *P*. ſo have you the Center of the Tropicke of ♋.extend the *Compaſſes* therefore from 1.to ♋. then may you deſcribe that *Tropicke*,viz.ſ. ♋.ζ. In like

manner

ıanner may you dravv the other *parallels*, but for more
aſe we may take halfe of the differences of the Num-
ers in the Colume *C* and the Colume *E*. and ſo may we
ave the Colume *F*.and then with greater expedition wee
ıay protract the Centers of theſe *parallels*, from *Z*.
or if 5269. which is at the bottome of the Colume *F*.
& betweene the former two Numbers)be taken from the
ale,and protracted from *Z*.it will reach uuto 1.the Cen-
r as before,and ſo any Number in the Colume *F*. is the
iſtance of the *Centers* from *Z*. of his oppoſite Number
ı the Colume *B*. or *A*. by which Columes *C*. and *F*.
ou may deſcribe all the *parallels*, betweene the *Tropicks*
om degree to degree.

But for more exactneſſe it were conveni-
ıt to ſhew in what points of the *Arke* δ.
·π.the parallels of *declination* interſect it,
truly deſcribed,and may be found by Page
7.of the *Appendix* upon the *Ring*,where is
ewne to finde what Amplitude belongeth
the Sunnes declination,for any *Latitude*
moving the *Sine* of the Complement of
e *Latitude*, uiz. this of *London*, 38. gr.
.m.uuto the *ſine* of 90. in the fixed, ſo
ery degree of *declination* in the moveable,
all point out the *Amplitude* in the fixed by
hich is had the Numbers of the Colume *T*.
e ſuns *Amplitude* belonging to the *declina-*
*on* of the Colume *R*.Now if the *Quadrants*
S. EN.WS.WN.be divided from E & W.
uler layed upon the Center *Z*. and to paſſe
the degrees in the ſeverall *Quadrants*,
ſwerable to the degrees of the Colume *T*.
e *Arkes* δ π.and ζ C. ſhall be noted in ſuch
ints as the parallels of the *declination*
ould interſect.

*Secondly*, move the *Tangent* of the *Lati-*
*de* in the moveable,viz.51.gr.30. m. unto
e former part of the *Radius* or ſcale. viz.
ooo. in the *Circle of Numbers* in the fixed,

| R. | T. |
|---|---|
| 1 | 1.36 |
| 2 | 3.13 |
| 3 | 4.44 |
| 4 | 6.26 |
| 5 | 8.03 |
| 6 | 9.40 |
| 7 | 11.17 |
| 8 | 12.55 |
| 9 | 14.33 |
| 10 | 16.12 |
| 11 | 17.51 |
| 12 | 19.31 |
| 13 | 21.11 |
| 14 | 22.52 |
| 15 | 24.34 |
| 16 | 26.07 |
| 17 | 28.01 |
| 18 | 29.46 |
| 19 | 31.32 |
| 20 | 33.20 |
| 21 | 35.09 |
| 22 | 37.00 |
| 23 | 38.53 |
| 23.30 | 39.50 |

ſo the Tangent of 45.gr. in the movable ſhall point out 125717.in the Circle of Numbers in the fixed, which taken from the ſcale *A*.and protracted from *Z*. to *T*. it ſhall be the *Center* of the houre of 6. upon *T*. erect a perpendicular 2.*T*.10. ſerving for the Centers of the other houres: then move the Tangent of 45:gr. to the parts of the ſcale, viz.10000 in the *Circle of Numbers*, and conſider the diſtance betweene the *Zenith* and the Pole,viz.38.gr.30.m. the Tangent of halfe of it in the movable doth point out in the Circle of *Numbers* 34921.which taken alſo frō the diagonall ſcale,and protracted from *Z*.will reach to *P*. the Pole; through which all the houres muſt be drawne, and the *Centers* of which houres in the line 2.10. from *T*. may be had thus: which two numbers 125717.& 34921.I place over the Columes *H*.and *I*.

Of the calculating of the diſtances of the Centers of the houres

*According* to the diſtance *P.T*.make a ſcale *B*.(or rathe a *diagonall ſcale*)to containe 10000. parts, then move th *Tangent* of 45.gr. to the parts of this ſcale in the *Circle o Numbers*, viz.10000. ſo every degree in the mouable amongſt the *Tangents* unto 45.gr.doth point out in the *Circle of Numbers*, the diſtances of the Centers of thoſe degrees from *T*.in the line 2.10. by which the Colume *H*. i made,then moving the moveable ſoftly along as the *Tangent* of any degree in the movable above 45.gr. paſſeth b the parts of the ſcale *B*. viz. 10000. in the *Circle of Numbers*, ſo the Tangent of 45.gr.in the moveable, paſſeth b the diſtance of the Centers of thoſe degrees from *T*.in th *Circle of Numbers* in the fixed, above 10000. by which i made up the reſt of the Colume *H*.viz.*I*.by helpe of whic Colume *H*.and *I*.the houres may be thus drawne.

Of the deſcribing of the houres

*Marke*, what Numbers are againſt the houres in th Colume *H* and *I*. for if thoſe Numbers be taken from th ſcale *B*.and protracted from *T*. in the line 2.10. they ſhal be the Centers of thoſe houres:ſo in the Colume *H*.again the houre of 7.or 5. is 2679, which take from the ſcale *B* and protract it from *T*.to 7. and from *T*.to 5. in the lin 2.10.then placing one foote of the *Compaſſes* in 7.and ex tending the other foote to *P*. deſcribe the houre of 7. an one foote of the *Compaſſes* at the ſame extent being pla ce

d in 5.ſhall alſo deſcribe the houre of 5. In like manner
ay be protracted from *T*.out of the Colume *H.I.*the *Cen-*
*rs* of the other houres with their intermediats, and ſo al-
deſcribed.

Of the fin-
ding the
interſecti-
on of the
houre with
the Hori-
zon.

*But* here note, that it were convenient to finde the In-
rſections of the *houre lines* (and their intermediate de-
ees)with the *Horizon* as before was delivered of the in-
rſections of the parallels of *Declination* with the *Hori-*
*n*,and it may be drawne from my *Ring* thus. Move the
angent of 45.gr. in the
oveable unto the *ſine* of
e *Latitude*,viz.51.gr.30.
.in the fixed, then right
ainſt the Tangent of any
gree from the houre of 6.
the fixed,is the Tan-
nt of the degrees of the
terſection of the houres,
d the intermediate de-
ees with the *Horizon* in
e moveable: from which
rection is this Table
rawne, and is onely for
heſe degrees which interſect the *Horizon* in the *Calender*,
ut it might have beene extended further. The
pplication of which is thus: Account in the *Limbe* of
e *Inſtrument* frō E.(the point of *Eaſt*,)any degree in the
*olume B*.and lay a Ruler thereto,and to the *Center Z*. ſo
e interſection thereof in the *Horizon* ſhall ſhew the in-
rſection that the *houre line* or degree oppoſite thereunto
n the *Colume A*.maketh with the *Horizon*. In like man-
er I might have delivered the Tables of the interſection
f the houre lines with the parallels of *declination*, which
vould ſerve of great uſe in large *Inſtruments*, to deſcribe
heſe degrees,which are neere the houre of 12.

| A | B | A | B | A | B |
|---|---|---|---|---|---|
| 1 | 1.16 | 12 | 15.12 | 23 | 28.29 |
| 2 | 2.33 | 13 | 16.26 | 24 | 29.38 |
| 3 | 3.50 | 14 | 17.40 | 25 | 30.48 |
| 4 | 5.16 | 15 | 18.54 | 26 | 31.56 |
| 5 | 6.23 | 16 | 20. 7 | 27 | 33. 4 |
| 6 | 7.39 | 17 | 21.20 | 28 | 34.12 |
| 7 | 8.55 | 18 | 22.33 | 29 | 35.19 |
| 8 | 10.11 | 19 | 23.45 | 30 | 36.25 |
| 19 | 11.27 | 20 | 24.57 | 31 | 37.21 |
| 10 | 12.42 | 21 | 26.08 | 32 | 38.36 |
| 11 | 13.57 | 22 | 27.18 | 33 | 39.41 |

Now to deſcribe the *Eclipticks*,conſider as before the hight
f the *Tropicks* above the*Horizon*, in the *Latitude* given,
iz.51.gr,30.m. ſo ♑ will be 15.above the *Horizon*, and
♋ will be 62.gr. high. Then move the *Tangent* of 45.

To deſcribe the Eclipticke

unto the parts of the ſcale *A*.in the *Circle of Numbers* i the fixed.viz.10000. ſo right againſt the Tangent of 15 gr.in the moveable is 2679.the diſtance of the Center o the Southerne ſemicircle of the *Eclipticke* from *Z*. whic I place in the Colume over *M*.and againſt ♑. then mov the moveable ſoftly along untill the Tangent of 62 gr.be right againſt 10000.in the *Circle of Numbers*,ſo the Tangent of 45.gr.in the moveable,ſhal point out 18807.on th *Circle of Numbers* in the fixed: The diſtance of the Center of the Northerne ſemicircle of the *Eclipticke*, from *Z* which I place in the Colume over *P*.againſt ♋. if theſ numbers be taken from the ſcale *A*. and protracted fro *Z*.they will reach from *Z*. to ♑.and from *Z*.to ♋, and ſ placing one foote of the *Compaſſes* in ♑.neere the *Pole* and extending the other foote to ♑. neere *S*. you may deſcribe the Southerne ſemicircle of the *Eclipticke E*,♑.*W* and placing one foote of the *Compaſſes* in ♋. below th Pole,and extending the other foote to ♋.above the *Pole* you may deſcribe the Northerne part of the *Eclipticke E* ♋,*W*. and thoſe ſemicircles of the Eclipticke may be divided as followeth.

How to make the Table to divide the Eclipticke

*Move* the Tangent of 45. unto the *Sine* of 66. and 3 ſo right againſt the Tangent of the degrees of the Sunne Longitude in the *Eclipticke* in the moveable,are the Tangents of the degrees of the Sunnes *right aſcention* in th fixed, or they may be had by reſolving of a *Triangle*, i which there will be 90. ſeverall operations, but by thi *Ring* they are given at one rectification, and onely by glance of the *eye*:for proportionals either in *Sines* or *Tangents* are had by the *Ring*, with the ſame expedition tha *Numbers* are had,As by the uſe of the *Circles* of *Sines* an *Tangents* upon the projection of this *Ring*, in diverſe particulars is declared in the *Appendix* upon the uſe of th *Ring*; and ſo according to the former Conſtruction i made the Columes *L*.and *O*.for 45. being brought to 66 gr.30.m.as before,right againſt 10.gr. in the moveable, i 9.gr.11.m. in the fixed,againſt 20.gr.in the moveable, i 18.gr.28.m.in the fixed, and ſo of the reſt. Then mov the Tangent of 45.gr. to the parts of the ſcale *B*. viz

1000

10000. in the Circle of Numbers, ſo right againſt the Tangent of the Arkes in the Colume *L.* in the moveable are the diſtances of the Centers of thoſe Arks, from *T.* in the *Circle of Numbers* in the fixed, and ſo is made the Colume *M.*& if you move the moveable ſoftly along as the Tangent of any degree in the Colume *O.* paſſeth by 10000 the parts of the ſcale *B.*ſo the Tangent of 45.in the moveable, paſſeth by the diſtances of the Centers of thoſe degrees from *T.*in the Circle of Numbers in the fixed, by which is made the Colume *P.* or they may bee had from the Table of naturall Tangents.

To divide the Eclipticke.

*Then by the ſcale B.*protract the *Numbers,*out of the Colume *M.*and *P.*from *T.*in the line 2.10. for they ſhall bee the *Centers* of thoſe degrees of the *Eclipticke,* which are oppoſite unto them,viz.in the Columes *K.* and *N.* ſo if I would interſect the *Eclipticke,* in the beginning of ♉.♓. ♍.or ♏.each being diſtant from ♈.30.gr. which I ſeeke in the Colume *K.*and finde right againſt it in the Colume *M.*5294. which I take from the ſcale B. and protract it from *T.*to 30.in the line 2.10. Now placing one foote of the *Compaſſes* in 30.next 10.and extending the other foote to *P.*the *Eclipticke* may be interſected in the points of ♉. and ♓.and placed in 30. towards 2.the ſame extent will Interſect the *Eclipticke* in ♍.and ♏. In like manner may the Centers of the reſt of the degrees of the *Eclipticke* be protracted in the line, 2.10. from *T.* out of the Columes *M.*and *P.*and ſo all the *Eclipticke* divided from degree, to degree : but this may be otherwiſe done.

Beſides that which is delivered touching the drawing of the *Parallels, Eclipticke,*and *Houre lines,* there remaines yet how to put on the *Callender,*to graduate the *Index,*and to draw,and divide the line of *Shadowes.*

This may be eaſily done from the Table *R.*Calculated, and accommodated to that purpoſe for the yeare 1640,and may ſufficiently ſerve for many yeares after, without any ſenſible error.

*Conſtruction.*

Having divided the *Quadrants,E.S.*and *E.N.*(as before into the uſuall degrees of a *Quadrant,*) lay a ruler upon the

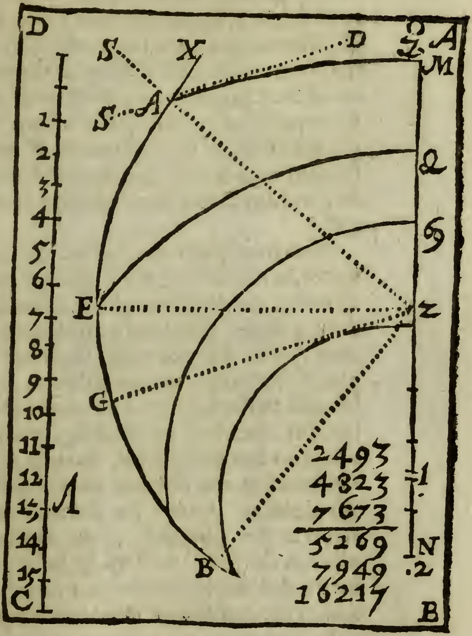
How to in-ſcribe the Callender

the Center *Z.* and account the degrees from the point *E.* in the *Quadrant* towards *N.* and *S.* out of the Table *R.* according to the ſeverall Columes of the Table *R.* and Interſect the *Quadrants*, with ſmall ſhort lines, ſo ſhall the Arke of the *Horizon* of the *Inſtrument* from E. be divided into the uſuall dayes of the *Month*, which is the *Callender* and the beginning of theſe diviſions, may be at the 10. of *March*, and ſo going on to the 11. of *Iune*, and then againe to begin from the 10. of *March*, and go on unto the 10. of *December*, and theſe dayes may bee noted upon the inſide of the *Horizontall* Arke with ſhort lines from E. as before, and at every *Month* may bee placed a repreſentative letter for that *Month*, and every 10. and 5. day of every *Month*, may bee noted with a ſmall ſtroke ſomewhat longer then the reſt, to helpe the memory the readier to number. In like manner may the reſt of the dayes of the *Calender* be interſected in the out ſide of the *Horizontall* Arke, towards the *Limbe*, beginning at the 13. of *September*, and ſo going on to the 11. of *Iune*, then againe from the 13. of *September*, and going on unto the 10. of *December*, and theſe *Months* may bee alſo noted with ſignificant letters, appropriate to each *Month*, and each 10. and 15. day of the *Month*, may be alſo denoted as before, with a ſtroke ſomewhat longer than the reſt, according to the Scheme againſt Page the 1.

# *How to graduate the Index for the Inſtrument.*

Let the *Index* be equall to the ſemidiameter, *Z.E.* and then may it bee divided out of the *Table Q.* by the helpe of the ſcale *A.* beginning at the Center: the *Index* being diuided, and placed on the Center of the *Inſtrument* at *Z.* it ſhall helpe to put on, and divide the line of *ſhadowes.* as followeth.

Lay the edge of the *Index* to *A.* in the *Limbe* which is neere the 10. of *December*, and move it to any degree in the *Table S.*and account the like degree in the *Index*, and then make a marke upon the plaine of the *Inſtrument* where that degree toucheth, and ſo goe on from point to point,untill the whole line bee deſcribed and divided, according to the *Table S.* This line might bee placed betweene the *Calender* and the *Limbe*, or in a *Quadrant*,&c. But I have cauſed it to bee deſcribed as is ſeene upon the *Scheme* againſt Page the 1. for expedition and conveniency. ☞

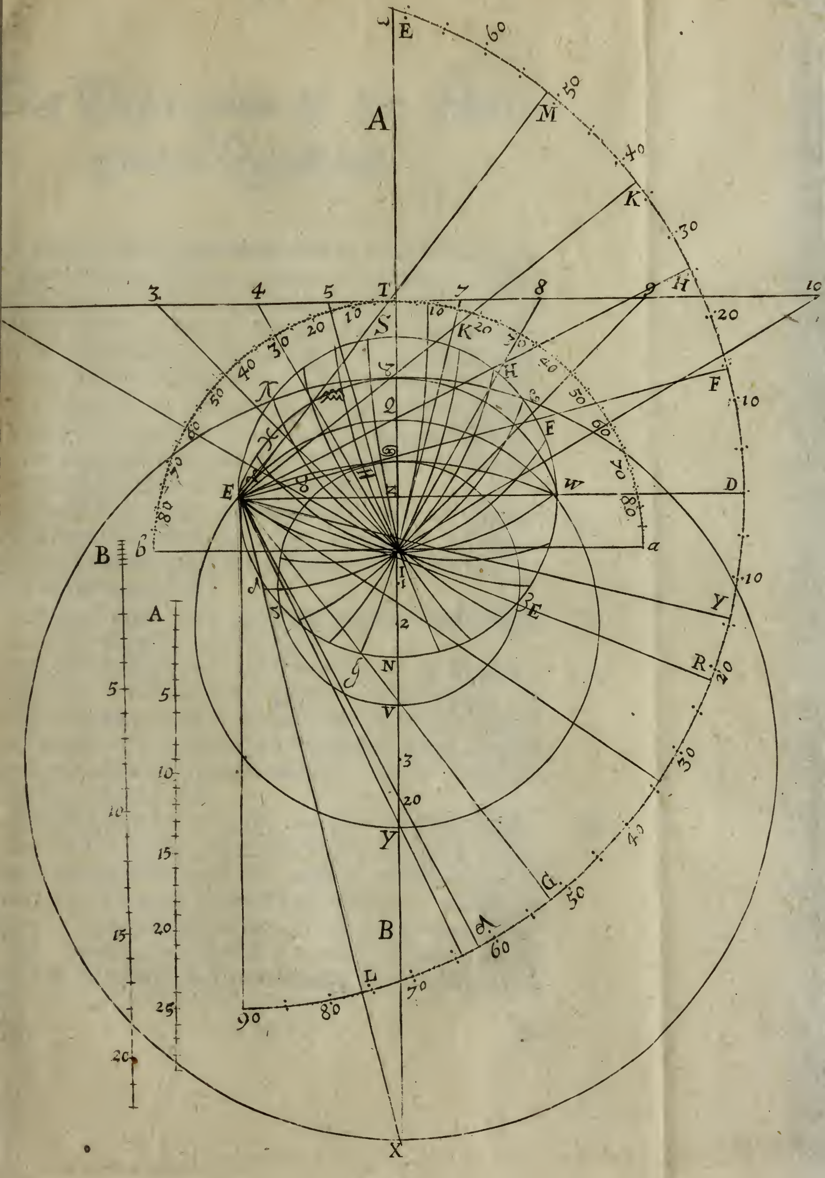


Now if any deſire to inlarge the *Inſtrument* to a proportion aſſigned, or to deſcribe the *Trapeziall* forme in the greateſt proportion upon a plaine given: without curioſity, it may bee done thus.

Let *A. B. C. D.* be a plaine, divide the length *A. B.* within halfe an Inch of the higher end, and an Inch of the lower end, in to 3.equall parts which ſuppoſe the line *M.N.* then divide each part into halfe ſo the line *M. N.* ſhall bee divided into 6.equall parts,the middle of which will bee at *Z.* Then take 4.of theſe parts for *Radius*, and on *Z.* deſcribe the obſcure *Arke*, *A. E.B.* and upon *Z.* erect a perpendicular to the line *M. N.* to cut the Arke *A. B.* in *E.* now from *E.* to *A.* protract 40. gr. and from *E.* to *B.* protract 50. gr. ſo the Angle *E. Z. M.* ſhall be 90. and alſo *A. Z. B.* ſhall be 90.. Now having made a ſcale of *Z. E.* like to the ſcale *A.* according to the former directions) then out of the Colume *C.* and by helpe of the ſaid ſcale *A.* from *Z.* you may protract *Z.*♋.2493. *Z.*♎.4823. and *Z.*♑7673. and from the Colume *F.* you may protract the diſtances of the *Centers* of thoſe interſections from *Z.* viz. Z. 1.5269. *Z.* 2.7949. and Z. 3.16217. and ſo placing the Compaſſe in theſe *Centers,* you may deſcribe the *Equator,* and both *Tropicks.* But if Z. *M,* and Z. *N.* be divided according to the ſcale *A.* then from Z. you may account the interſections of the parallels, and diſtances of the Centers, and ſo deſcribe the parallels with greater expedition, and ſo ſhall you haue the *Scheme* or *Trapeziall* forme of the *Inſtrument, B. A.* ♑.♋. and may bee finiſhed according to that againſt Page the 1. by the *Tables* and directions here calculated, and delivered to that end.

Now to augment the *Inſtrument* to any proportion aſſigned, as if betweene the *Tropickes* were ſuppoſed to bee 10. *Inches,* the *Radius* might be found out, or if the *Radius* were 4. foote, (which is according to mine owne *Inſtrument*:) what diſtance might there bee betweene the *Tropickes*: the proportion would be as 516. to 1000. ſo the breadth to the ſcale, or as 1000. to 516. ſo the ſcale to the breadth: therefore by the *Ring,* bring 516. in the moveable, to 1000. in the fixed, ſo right againſt any *Radius* in the fixed, is the diſtance betweene the *Tropickes* in the *Moveable,* or againſt the diſtance aſſigned for the *Tropickes* in the *Moveable,* is the meaſure of the *Radius* or *Scale,* in the *fixed*: So if ♑:♋. be allotted to be 10. *Inches,* for the diſtance betweene the *Tropickes,* the *Scale,* or *Radius,* of the *Inſtrument* ſhould be $19\frac{4}{10}$. fere: but if the ſcale or *Radius* were 4. foote, or 48. *Inches,* then the diſtance betweene the *Tropickes* of ♑, and ♋. will be neere $24\frac{77}{100}$. *Inches.* Thus for the making of the *Inſtrument,* the deſcription of which followeth.

The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# The Deſcription of the Horizontall Quadrant.

He forme of this *Inſtrument* is like a mixt *Trapezia*, as
appeares againſt Page. 1. where of two ſides are right,
d the other two ſides are *Circular*, which falleth out to
e ſo from the nature of the *Projection*, and that part
hich I have thought moſt convenient for uſe, and is fully
fficient for that which I have deliuered upon it; and
ay be made of any plaine *Materiall*, but fitteſt in *Braſſe*,
*Silver*: the ſeverall parts of which *Inſtrument* are five,
z. the *Backe*, the *Face*, the *Sights*, the *Index*, and the di-
ſions, and lines projected on the *Face*.

*Firſt, the Backe of the Inſtrument*, is a part of *Gemma* 1.
*riſius* projection, whoſe particular deſcription and admi-
ble uſe I intend here after as God ſhall give life and A-
lity to make manifeſt.

*Secondly, the face of the Inſtrument*, is that upon which 2.
e *Index*, and ſights are placed on.

*Thirdly, the Sights are* the ſmall peeces of *Braſſe* in 3.
hich there is in each a little hole to looke through, or
e ſunne beames to paſſe through, and are faſtned upon
e *Face* of the *Inſtrument*; one of which Sights is neere
e *Center* of the *Inſtrument*, and the other is neere the
*ircumference* thereof.

*Fourthly, the Index*, is the movable peece of braſſe, 4.
ſtned at the *Center*, upon which alſo two other ſights
ay be placed, the edge of this *Index* is divided and noted
us. 10.20.30.40.50.60.70.80.90. which are called the
egrees of the *Index*, and there is adjoyned unto it three
nall plates to be rectified as occaſion requires, one of
hich is called the *Axis*, and the other two are perpendicu
rs.

5 *Fiftly*,the lines deſcribed on the *Face* of the *Quadrant* are ſixfold.

Viz.
- *The Limbe and its Parallels.*
- *The Kalender and its diviſions.*
- *The Æquator and its Parallels.*
- *The Eclipticke and its diviſions.*
- *The Houre lines and their intermediates.*
- *The line of Shadowes and its diviſions.*

1. *Firſt*,the *Limbe* is the outmoſt *Circle*, which is divide into 140.gr.and noted at every 10.degree thus, 10.20.30 40.50.60.70.80.90.and each of theſe degrees is divide into parts according to the Capacity of a degree in th *Inſtrument*.

2. *Secondly*, the next parallell line to the Limbe is the *Horizon* or *Kalender*, which is noted with letters thus, *I.A S.O. N.D. I.F. M.A. M.I.* of which *I.*in the firſt plac ſtands for *Iuly*,*A.*for *Auguſt*,*S*·for *September*,*O.*for *October*. &c.then againe on the inſide, *I.* ſtands for *Ianuary F.*for *February*,&c. each letter repreſenting its *Month* and each of thoſe *Months* is divided into dayes by ſmal ſhort lines,whereof the 10.and 15. day of every *Month* i ſignified by *Numbers*, or elſe by a line ſomewhat longe then any of the others, to helpe the *memory* the readier t *Number*,and for more promptneſſe of finding the day o the *Month*,in the *Kalender* as occaſion requireth.

3. *Thirdly*,*The Equator* is that line that meeteth with th tenth of *March*, and the thirteenth of *September* in th *Kalender*, and is divided into degrees , and numbre thus,10.20.30.40.50.60.70.80.90. and the parallels t the *Equator* are theſe lines which are on each ſide of it every 5.degree of which being noted thus,5.10.15. 20.th outmoſt of thoſe *Parallels* on each ſide of the *Equator* ar the two *Tropickes* that which is neareſt the *Center*, is called the *Tropicke* of ♋, and that which is fartheſt of, i called the *Tropicke* of ♑, thoſe two *Tropicks*, the *Kalender*, and the houre of 12. comprehend the whole *Projection*: and here note farther that theſe parallels are calle

parallel

rallels of the day of the *Moneth*,as well as the parallels
the Sunnes *Declination*, according as they ſhall be
ed , and farther below the *Tropicke* of *Cancer* is a
aduation of the common houres of a *Horizontall*
yall : ſome vſe of whſch is ſhowne,by pro.36.

4. *Fourthly*,*the Eclipticke* on the inſtrument is repreſen-
d by two quarters of the *Eclipticke* which croſſeth the
rmer parallels, and meeteth with the *Equator*, in the
*orizon* or *Kalender*, in the former 10 .of *March*, and
3.of *September*: that *Quarter* which is towards the *Cen-*
*r* of the *inſtrument*, ſerves for the *Northerne ſemicircle*
the *Eclipticke*, and that which is farther from the *Cen-*
*r* ſerves for the *Southerne ſemicircle* of the *Eclipticke* ;
each of theſe *ſemicircles* is divided into the *Signes* of the
*odiacke*, & charactered accordingly thus,♈.♉.♊.♋.♌.
♍.♎.♏.♐.♑..♒♓.Of which the firſt 6.*Signes* are called
*ortherne ſignes* and are in the *Northerne ſemicircle*,& the
her 6.*Southerne ſignes* & are in the *Southerne Semicircle*.
nd each of thoſe *ſignes* is divided into 30. gr. and if the
*nſtrument* be large,each of theſe degrees may be divided
ito 6.or 12.diviſions more, So every diviſion ſhall ac-
ordingly containe 10. or 5. Minuts.

5. *Fiftly*,*the houre lines* are thoſe that croſſe the *Æquator*
nd his parallels, and are noted, or numbred in the *Tro-*
*icke* of ♋ with *numerall Characters* thus IIII. V. VI.
II. VIII. IX. X. XI. XII. And are the forenoone
oure notes: thoſe hourelines ſerve alſo for the after-
oone houres,and are noted likewiſe with *Arithmeticall*
igures,for the houres in the afternoone thus, 1.2.3.4.5.
.7.8. each of thoſe houres is divided into 3.parts, each
art being 20. minuts : and each of thoſe parts is ſubdi-
ided againe into 5. parts, ſo that each part containeth
.minutes, and ſo the whole houre is diveded into 15.
arts or degrees, each part or degree being 4. minuts
as afore,and ſo the whole houre ſhall containe 60. minuts
or parts: and here note that theſe *Houre circles* with their
intermediates are alſo called *Meridians* or degrees of
meaſure,and are *Numbred* by tens in the *Æquator*, from
the meeting of the *Æquator* with the *Eclipticke*,as before

thus,

thus,10.20.30.40.50.60.70.80.90.

*Sixtly,the line of ſhadowes* is that which makes a *ſphæricall Equilaterall Triangle* upon the plaine of the *Inſtrument*,the baſis of which is the *Horizon*, or *Kalender* and one of whoſe legges is below the *Tropicke* of ♋ and the other croſſeth the *Tropicke* and parallels, and meeteth with the *Kalender* neere in the 10. of *December*: both of thoſe equall ſides are called the line of *ſhadowes*, and are divided alike into 10.vnequall diviſions,and each of thoſe diviſions againe is divided into 10·other diviſions, and againe each of them into other 10. (if the *Inſtument* be large.)The firſt Capitall 10. diviſions are noted with *Arithmeticall figures* thus,1.2.3.4.5.6.7.8.9.10. of which 1. is at the very meeting of the two lines,not farre from the *Center*,which ſignifieth *Equall*:the figure of 2.*Double*: the figure of 3.*Triple*, the figure of 4.*Quadruple*: the figure of 5.*Quintuple*,&c,*Thus for the making,and deſcription of the Inſtrument, the uſe of it now followeth.*

Of

# Of the Vſes of the Horizontall Quadrant, ſpecified in the *Index* or *Table*, formerly delivered.

OF which ſome have relation to the obſervation or appearance of the *Sunne*, others thout obſervation, or ſight of the *Sunne*.

The Vſes of theſe which are knowne without eing the *Sunne*, are 30. of the ſaid *Index* or *ble*, as followeth, viz. the 2. 9. 10. 12. 13. 14. . 16. 17. 18. 19. 20. 21. 23. 24. 25. . 27. 28. 29. 30. 32. 33. 35. 37. . 39. 40. 41. and 42. of which 13. of them ill be ſhowne onely by knowing the day of the *onth*, viz. the 18. 33. 21. 19. 25. 24. 35. 38. 37. 20. 41. and 42 as followeth.

The

The day of the Month knowne to finde.

1. *The houre of Sunne riſing, ſetting, and length of the day.*
2. *The Sunnes difference of Aſcention.*
3. *The Sunnes Declination.*
4. *What dayes are alike in length, and what day the Sunne riſing in the one, ſhall be the Sunne ſetting in the other.*
5. *The Sunnes place, or degree in the Eclipticke.*
6. *The Sunnes right Aſcention, and oblique Aſcention.*
7. *The houre, and Altitude of the Sunnes comming Eaſt, or Weſt.*
8. *The diſtance of the Sunnes riſing, or ſetting, from the Eaſt, or Weſt.*
9. *The height, or depreſſion of the Sunne in the Meridian here, or for any Latitude.*
10. *The time of day breake, and end of twylight.*
11. *The inequality of time, betweene day breake, and Sunne riſing.*
12. *The houre, and Altitude of the Sunne comming upon any declining wall.*
13. *At what houre, and Altitude, the Su muſt have to be oppoſite or perpendicular to a declining wall.*

*Firſt*

# *Firſt, to finde the time of Sunne riſing, or ſetting, and length of the day, for any day of the yeere.*

*Pro. 1.*

*Conſtru-*
*ction. 1*

*Seeke* the day of the *Month* in the *Kalender*, and the *houre line* that meeteth therewith, ſheweth the time of *Sunne riſing, or ſetting.*

*Exam.*

So if the day of the *Month* were the 13. of *October*, the parallell that meeteth therewith is the *houre*, viz. 7. of the clocke, at which time the Sun riſeth: the ſame *houre* is noted alſo with 5. which is ÿ time of *Sun ſetting* that day, this doubled makes 10. the length of the day required.

# *Secondly, to finde the difference of Aſcention, for any day of the yeere.*

*Pro. 2.*

*Conſtru-*
*ction. 2.*

*Marke* what *Meridian* meeteth with the day of the *Month* in the *Kalender*: as ſuppoſe the day to be the former 13. of *October*, which is the *houre line* of 7. and 5. (as before) and account the Numbers of *Meridians* to the *houre* of 6. ſo have you 15. gr. or an *houre*, which is the difference of *Aſcention* for the 13. day of *October* required.

## Pro.3 *Thirdly, to finde the Sunnes declination for any day.*

*Conſtructio.3.* *Marke* what parallell of *Declination* meeteth with the day of the *Month* in the *Kalender*, and account how many degrees it is from the *Equinoctiall*, ſo have you the *Sunnes Declination* for that day.

*Exam.* So if the day were the laſt of *Auguſt*, the parallell that meeteth therewith is the 5th.from the *Equator*,and ſomuch is the *Sunnes declination*,that day,viz.5.gr.*North declination.*

## Pio.4. *Fourthly, to finde what dayes in the yeare are alike in length, and what day the Sunne riſing in the one, ſhall be the Sunne ſetting in the other.*

*Conſtruction.4.* *For the firſt*,note that the dayes betweene the 10th.of *December* and the 11th. of *Iune*, are dayes of Increaſe, and the reſt are dayes of Decreaſe. Now right againſt any day of decreaſe in the *Kalender*,is the day of increaſe, which dayes are equall one to the other. So the 19. day of

*Exam.* *May*,is againſt the 4. of *Iuly*, at which time the *Sunne* riſeth and ſetteth alike without ſenſible

rror,viz. 4. of the clocke, and therefore thoſe
ayes are of equall length,and ſo of others.

## For the ſecond, to finde what day he ſunne riſing in the one, ſhall be he ſunne ſetting in the other.

*Admit* the day to be the 18th.of *February* and
cording to the firſt pro. finde the time of *Sunne* *Exam.*
*ſing*,which is at 40. m. after 6. of the clocke *Conſtru-*
r that day,and the ſetting 20. m,after 5. then *ctio.5.*
arke what day of the *Month* the *houre* line of
0 m, after 5.in the forenoone, meeteth with
e *Kalender*,which will be the 23. of *Auguſt*,ſo
e 18th. day of *Februarj* the Sun did ſet at the
me houre that it did riſe,the 23.day of *Auguſt*.

## ifthly,to finde the ſunnes place,or Pro.5 egree, for any day of the yeere.

*Note* where the parallel of the day of the
*onth* croſſeth the *Eclipticke*, that is the *Sunnes* *Conſtru*
ace.So the former parallell of the 13th.of *Octo-* *ctio.6.*
*r* meeteth with the *Eclipticke* in the beginning *Exam,*
♏, and ♓, but which of theſe is the *Sunnes*
ace, the quarter of the yeare may eaſily tell you,
z. ♏ which is the *Sunnes* place or the degree
the *Eclipticke* for that day.

## Pro.6. Sixtly, to finde the Sunnes righ aſcention, and oblique aſcention a any time.

*Conſtru ctio.7*

*Conſider* what *Meridean* meeteth with th
Sunnes place in the *Eclipticke* for the day give
and marke the number of *Meridians* in the *Equ*
*tor*(for the *Meridians* are numbred in the *Equato*
as is ſayd before in the deſcription) ſo have yo
the Sunnes right *Aſcention:* but here note that th
degrees in the *Eclipticke* are numbred forwa
and backeward in the *Eclipticke* unto 360. g
upon this *Inſtrument:* ſo are the right *Aſcentio*
of thoſe degrees alſo numbred forward a
backward in the *Æquator*: for the right aſce
tion of any degree in the *Eclipticke*, is that degr
of the *Æquator* which is oppoſite unto it, ( th
ſucceſſion of the *ſignes* conſidered ) ſo if the *S*
were in the beginning of ♏, the right *Aſcenti*
is neere 208. degrees, for the *Meridian* that pa
ſeth by the beginning of ♏, is accounted in th
*Equator* from ♈, and is within 6.m, of 28. g
*Now* the right *Aſcention* of ♋, is 90.gr. and th
beginning the of ♎, is 180.gr. and from th
beginning of ♎, to the beginning ♏, is with
6.m, of 28.gr. as before, all is which put tog
ther makes neere 208. gr. the right *Aſcenti*
of the *Sun* the 13th. day of *October*.

# To find the Sunnes Oblique Aſcention at any time.

*Note* that the difference of *Aſcention*, is the *Conſtru*
fference alwayes betweene the right *Aſcention* *ctio.8.*
the *Sun*, and the oblique *Aſcention* thereof: ther-
re the right *Aſcention* known by the laſt di-
ctiō, & the difference of *Aſcention* by the ſecond
rection, the oblique *Aſcention* is eaſily had, by
*ddition*, or *ſubſtraction* thus. If the *Sun* be in a
*utherne ſigne* then the *oblique Aſcention*, is grea-
r then the right *Aſcention*, by ſo much as the
fference of *Aſcention* comes to: but if the *Sun*
in a *Northerne ſigne, the oblique Aſcention* is ſo
uch leſſe: which difference of *Aſcention* as be-
re by the 2 *Pro*: for the ſaid 13th. of *October* was
5.gr. this ad unto the right *Aſcention* of the be-
nning of ♏, viz. 208.gr. makes 223.gr. the *Suns*
*lique Aſcention* for the beginning of ♏, on the
3th. day of *October*; but if the *Sun* had beene in
e beginning of ♉, the *oblique aſcention* would
ave beene onely neere 13.gr. viz. 12.gr. 54.m.

## eventhly, to find the ſuns Alti- ude, and houre of the ſuns com- ning Eaſt, or Weſt, any day of the eare above the Horizon. Pro.7.

*Here* note that this *Propoſition* holds in uſe *Conſtru-ctio.9.*

onely for that time of the *Suns* being in the *Northerne ſignes* that is from the 10th.of *March* to th 13th. of *September*: therefore lay the *Index* to th *Eaſt*,or *Æquinoctiall point* noted with *E*.or 40.& 50. in the *Limbe*: ſo have you inſtantly at onc without farther rectification both the *Altitud and houre* of the *Suns* comming *Eaſt* or *Weſt*, above the *Horizon* for all or any of the dayes above ſpecified: ſo the parallel of any day of th *Moneth* meeting with the edge of the *Inde* gives the Suns *Altitude* in the *Index*, and th *Meridian* meeting therewith ſhewes the *houre*

*Exam.* *So* if it were the ſecond of *May*, or the 22.o *July*, the parallel belonging to thoſe daies meete with the *Index* neere about, 23.gr.17.m, an there alſo meetes with that point, the *houre lin* of 7, and 5. which ſheweth that when the *Sun* i 23.gr.17.m, high either upon the ſecond of *Ma* or the 22.of *July*; then the *Sun* will be due *Eaſt* o *Weſt*, and that will happen to be at 7 of the clock in the forenoone, and 5. of the clocke in the afternoone.

## Pro.8. *Eightly, to find the diſtance of th ſuns riſing, or ſetting, any day o the yeare, from the Eaſt, or Weſt, called the ſuns Amplitude.*

*Conſtructio,12.* *Lay* the *Index* to the day of the *Moneth*, for th

time

ime given,& the edge of it in the *Limbe* of the *Inſtrument* ſhall ſhew the *Amplitude* required.

*So* if the day were the 13th. of *October* the number of degrees from the points of *Eaſt*, noted vith 40. 50. unto the *Index* is 18. gr. 40. m. which is the *Suns Amplitude* for the given day, viz. the 13th. day of *October*. *Exam.*

## *Ninthly, to know the ſuns Meridionall Altitude, or the ſuns depreſſion under the Horizon, at Midnight here, or in any Latitude, for any day in the yeare.* *Pro.9*

*Lay the Index* unto the *houre* of 12, and where he parallel of the day of the *Moneth* meeteth therewith ſhal be the *Suns Meridionall Altitude.* *Conſtructio.11.*

*So* if it were the 13th. day of *October*, as before, he parallell, for that day is 11.gr. and a halfe rom the *Equator South*: this croſſeth the *Index* n 27.gr. which is the Sunnes *Meridionall Altitude* that day. Now for the Sunnes depreſſion at midnight, here is to be noted, that any degree of he *Eclipticke* is at any time ſo much below the *Horizon*, as his oppoſite degree in the *Eclipticke*, is bove the *Horizon* at the ſame time. *Exam.*

*Therefore* where the contrary parallell of the *unne* viz. 11.gr. and a halfe *North*, meeteth with *Conſtruction.12.*

the *Index* in the houre of 12. that ſhall bee the *Sunnes Meridionall depreſſion* at midnight, the ſaid 13th. day of *October*.

Pro. 10.

## *Tenthly, to finde the time of day-breake, and end of twy-light, with the Poſition of the ſunne under the Horizon for any time.*

*This propoſition*, hath reference to the Sunnes depreſſion under the *Horizon*, for it is ſaid to bee day breake or twi-light to end, when the *Sun* is, 18. gr. under the *Horizon:* therefore the Conſtruction in this will be thus.

*Conſtructio.* 13. Account 18. gr. on the *Index* then move the *Index* untill that degree meete with the Contrarie parallel of *Declination* for the day given, ſo the *Meridian* or *Houre-line* that meeteth therewith ſhall bee the *houre* of day breake required.

*Exam.* So if the day were the 10. of *Aprill*, the parallel of *Declination* for that day is *North* 11. gr. and a halfe which I ſeeke out one the other ſide of the *Æquator* viz. 11. gr. and a halfe *South Declination*, and Marke where the 18th. gr. of the *Index* meeteth therewith, for there alſo is the *houre* of day breake *viz.* with in 20. m. of 3. in the Morning, and 20. m. paſt 9. for the end of *twi-light* the ſayd 10th. of *Aprill*, alſo the *Index* in the *Horizon* at that Inſtant ſheweth the poſition of the *Sun* under the *Horizon* viz. neere 48 gr. 10. m. to the *North* of the *Eaſt*: but if the day had beene the 13th of *October* the houre of *day breake* had beene 2 minuts before 5. and *twi-light* would have ended 2. m. after 7.

## *Eleventhly, to finde the inequallitie of time, betweene day breake and Sun riſing, for any day of the yeare aſsigned.* Pro. 11.

Conſtuct. 14

By the firſt *Conſtruction*, for the dayes given finde the time of *Sun riſing*, and by the former 13th Conſtruction the *houre* and time of *day breake* belonging to thoſe dayes: then compare the time betweene the *Sun riſing, and day breake* of the one, with that of the other, ſo the difference of thoſe two, ſhall bee the difference of time required.

*Example.*

| So on the tenth of | | H. M. | | H.M. | |
|---|---|---|---|---|---|
| *March* the | *Sun riſing is at* | 6. 00 | *The time betweene day breake and Sun riſing is.* | 2. 0 | the difference is, 12. m. |
| | *day breake is at* | 4. 00 | | | |
| *Decemb*, the | *Sun riſing is at* | 8. 12 | | 2. 12 | the difference is. 1. ho. 22. m. |
| | *day breake, is at* | 6. 00 | | | |
| *May the* | *Sun riſing is at* | 4. 11 | | 3. 34 | |
| | *day breake, at* | 12, 37 | | | |

So the difference of time betweene *day breake and Sunne riſing* the 10th of *December* is neere a quarter of an *houre* longer then that of the 10th of *March*; but more then an *houre* and halfe longer betweene *day breake, and Sun riſing* the 10th of *May*, then the 10th of *March*.

## Pro. 12. Twelfely to finde the houre, and Altitude of the ſunnes comming upon a Declining wall any day of the yeare.

☞ *Seeing the declinations of Plaines, or Walls*, are accounted from the points of *Eaſt* or *Weſt* in the *Horizon*, as the *ſunnes Amplitude* is the numbering of them therefore ſhall bee alike, in the *Limbe* of the *Inſtrument*. Now admit the *Declination* of a *Plaine* or *Wall*, to be 22. gr. the opperation would be thus. *Conſtruction. 15.* The *Index* being ſet thereto, you may inſtantly ſee at what *houre* the *Sunne* will come upon the *Plaine*, for any day in the yeare; for where the parallell of the day of the *Moneth* croſſeth the *Index* amongſt the *houre-lines*, (which *Index* repreſents the *Plaine*) that is the *houre* of the *Suns* comming upon the *Plaine* and the degrees in the *Index* gives the *Sunnes Altitude*. *Examp.* So if the Sunne were in the *Tropicke* of ♋ the *Tropicke* meeteth with the *Index* almoſt within 5 m. of 9 in the Morning, and at that time the *Sunne* commeth upon the *Plaine*, and there the *Tropicke* cuts alſo the *Index* in 45. gr. 40.

.m.which is the *ſuns Altitude* at that time that
*un* wil glance or begin to ſhine upõ the *Plaine.*
As for the time of the *ſuns* continuance on the
*laine* ( as is ſpecified in the *Index* or *Table* ) ac-
unt the *Declination*, on the other ſide of the
*aſt* point,and lay the *Index* thereto, ſo the edge
it in the *Tropicke* of ♋, will point out at what
ure the *Sun* goes of the *Plaine* viz. at 6.of the
ck & 38.m,neere;if the *declination* were *Weſt*,
s here it is ſuppoſed) which added to the time
the *ſuns* cõming on the *Plaine*,makes 9.*houres*
.m,& ſo long the *ſun* ſhines on the *Plaine*.

## *hirteenthly, to finde at what oure, and Altitude the ſun muſt ave to be oppoſite, or perpendicu-r to a declining Plaine, any day the yeere.*

*Pro. 13.*

*Example.*

*Conſtructio.16.*

*Let a Plaine decline* from the *Eaſt* point to-
ards the *South* 22.gr.account this in the *Limbe*
om the *houre* of 12. and lay the *Index* thereto,
the parallell that croſſeth the *Index*,doth ſhew
e *Sunnes Altitude*, and the *Meridian* meeting
erewith,gives the *houre*,at which time the *Sun*
ill be oppoſite to the *Plaine*; ſo have you at one
ſtant for every day in the yeare, at what *houre*
d *Altitude*, the *Sunne* will bee oppoſite to the
*aine.*

As

| As admit the dayes were theſe. | the tenth, the Suns place at which time is in | and the houre of the Suns being oppoſite to the plaine, that day would be at | and the Suns Altitude at that time would be, gr. m. |
|---|---|---|---|
| *Decem.* | ♑ | 40 m paſt. 1 | 12.12 |
| *March.* | ♈ | 14 m paſt. 1. | 36.25 |
| *Iune* | ♋ | 48 m paſt 12 | 60.45 |

Thus touching the reſolution of the former 13 uſes of the aforeſaid *Table*, or *Index* which had reference only to the knowledge of the day of the *Month*, there are 13. other *uſes* of the foreſaid *Index*, or *Table* viz. the 10.12.32.39.40.23.17.16.26.27.28.29.30. Which have no dependance upon the ſight of the *Sun*, of which the 6 firſt are reſolued, only by knowing the day of the *Month*, and the other 7. are as followeth.

viz by knowing the day of the Month to finde.

1. *At what houre the ſhadow of an Altitude is equall, double, triple, &c. unto it.*
2. *At any houre and Altitude of the Sun, or Azimuth, what proportion ſhadowes have to their bodies.*
3. *The houre of the day agreeable to any Altitude, or Azimuth.*
4. *The Suns depreſſion and Azimuth at any houre of the night Aſſigned.*
5. *The houre of the day to our Antipodes, by ſupoſing the Suns Depreſſion under the Horizon.*
6. *At what houre in any day the Suns Azimuth and Altitude will be equall, and how much the Altitude and Azimuth will be.*

*7. When*

To finde.

7. *What number of dayes will make the day an houre longer, or ſhorter at any time.*
8. *The inequalitie of time in equall moneths, or equall number of dayes.*
9. *The degree of the Æquator in the Horizon, by ſuppoſing any degree of the Eclipticke in the Horizon.*
10. *The degree of the Eclipticke in the Horizon by ſuppoſing the degree of the Equator in the Horizon.*
11. *The degree of Medium Cœli, or the degree of the Eclipticke in the Meridian, by ſuppoſing the degree of the Eclipticke in the Horizon, vel contra.*
12. *The Horoſcope, or the degree aſcendant, or deſcendent, and the Nonageſſima degree at any houre.*
13. *What Angle the Eclipticke makes with the Horizon, or the Altitude of the Nonageſſima degree, & what Azimuth it is in at any houre.*

## Firſt, to finde the Proportion of Proſhadowes to their Altitudes at any time. 14.

*As* if it were required the 20 of *Aprill*, at what oure of the day, and how high the *Sun* muſt be ither in the *forenoone* or *afternoone*, that the ſha- **Declaratio.*

dow of a *man* or any *Altitude*, ſhall be equall unto his height *double, triple, quadruple Quintuple* &c.

*Conſtructio*, 17. *Lay* the *Index* unto the numbers in the line of *ſhadowes* viz. to 1. 2. 3. 4. 5. &c. and whereſoever any of thoſe diviſions in the line of *ſhadowes* meete with the *Index* amongſt the degrees; there it ſheweth what height the *Sun* muſt have, to make the *ſhadowes equall, double, triple* &c. to the *Altitude*.

*Exam.* So laying the *Index* upon 1 in the line of *ſhadowes*, it meeteth with 45. gr. in the *Index*: & ſo high the *Sun* muſt be to make the *ſhadow of a man* or any thing equall to his height upon an *Horizontall plaine*: then move the *Index* to and fro, untill the ſaid 45. gr. in the *Index* meete with the parallel of the day *Month*, viz the 20. of *April*; ſo the *houre line* that meeteth therewith, is the *houre* of the day that the *ſhadow* of a *Man*: or other *Altitudes*, will be *equall* to his heigth or *Altitude*, viz neere 10. of the Clocke in the *forenoone*, or 2. of the Clocke, in the *afternoone*.

| And according to the ſame directions when ſhadows are | | The *Altitude* would be. | gr. m. | And the *houre* the ſaid 20. of *Aprill* would be, | fore-noone. ho. m. | after-noone ho. m |
|---|---|---|---|---|---|---|
| | *Double.* | | 26. 33 | | 7. 37 | 4. 23 |
| | *Triple.* | | 18. 26 | | 6. 43 | 5. 17 |
| | *Quadruple.* | | 14. 2 | | 6. 16 | 5. 44 |
| | *Quintuple.* | | 11. 19 | | 5. 58 | 6. 0 |
| | *Sextuple.* | | 9. 27 | | 5. 46 | 6. 1 |
| | *Septuple.* | | 8. 7 | | 5. 37 | 6. 23 |
| | *Octuple.* | | 7. 7 | | 5. 31 | 6. 29 |
| | *Nonocuple.* | | 6. 20 | | 5. 25 | 6. 3 |
| | *Decuple.* | | 5. 43 | | 5. 21 | 6. 3 |
| | *Vigecuple.* | | 2. 51 | | 5. 2 | 6. 5 |

*Secondly*

## *Secondly, to finde what proportion ſhadowes have to their bodies at any houre in the day, Azimuth, or Altitude of the Sun aſigned.* Pro. 15.

Conſtructio. 18.

If the *houre* be knowne, or ſuppoſed, move the *Index* until it meete with the houre in the parallel of the day of the *Month*, ſo the interſection of that parallel with the *Index* is the *ſuns Altitude*, and the edge of the *Index*, in the *Limbe*, wil ſhew the *Suns Azimuth*, then move the *Index* until the degree of *Altitude* interſect the *line of ſhadowes*, ſo ſhall you have the proportion of *ſhadowes*, to their bodies required.

Exam.

So if on the 11th. of *Aprill* at, 7. of the *Clocke* in the *forenoone*, (if the *Sun* ſhine,) it were required what proportion the *ſhadow* of a *man* ſhall beare to his height, or the *ſhadow* of an *Altitude* to the *Altitude*, the parallel that belongeth to the given day is neere 12.gr. *Marke* where this parallel meeteth with the given *houre* of 7. and bring the *Index* to it; ſo have you the *Suns height* at that *houre* viz 18.gr.26.m, and the edge of the *Index* in the *Limbe* of the *Inſtrument*, ſhall give the *Azimuth* viz 4.gr. from the *Eaſt* : then move the *Index*, untill the degree of the *Suns Altitude* viz 18.gr.26.m, meete with the line of *ſhadowes* which will be in 3, which ſheweth that at 7. of the Clock in the *forenone* the ſaid 11th.of *Aprill*, the *ſhadow* of a *man*, or the *ſhadow* of an *Altitude*, ſhall be *Triple* to his *height*: the like will be at 5. of the *Clocke* in the *afternoone*, for equall diſtances of the *Sun* from the *Meridian* the ſame day, without ſenſible error, will give equall *Altitudes* of the *ſun*, and equall *Altitude* of the *ſun* doth produce equall *ſhadowes* upon *Horizontall Plaines*.

*Conſtructio.* 19. *Secondly*, if the *Poſition* or *Azimuth* of the *Sun* be knowne or ſuppoſed, which admit 4 gr. from the *Eaſt* towards the *South*.

*Lay* the *Index* unto it in the *limbe*, & marke what degree in the *Index* the parallel meeteth with, which is with 18.gr.26.m, ſo have you the *ſuns Altitude* in the *Index*: then move the *Index* until yͤ degree meete with the *Line* of *ſhadowes*; ſo have you the proportion of *ſhadowes* required at that inſtant, viz *Triple* as before.

*Conſtructio.* 20. *Thirdly*, if the *Suns* height be knowne or ſuppoſed, which admit 18.gr.26.m, account it in the *Index*, and moove the *Index* until that degree meete with the *line of ſhadowes*; ſo where it interſecteth the *line of the ſhadowes*, there you have the proportion of *ſhadowes* to their *bodies* at that inſtant of time required, which will be *triple* as before; ſo the 10th. of *Aprill* if the *houre* be 7. or the *Altitude* 18.g.26.m, or the *Azimuth* 4.gr. from the *Eaſt* toward the *South*, the proportion of *ſhadowes* to their bodies will be *Triple*.

*Thirdly*,

## *Thirdly to finde the houre of the day agreeable to any Altitude or Azimuth, for any day of the yeare Propoſed.* Pro. 16.

*For the firſt* account the *Suns Altitude* in the *Index*, and move it to and fro untill that degree meete with the parallel of the day of the *Month*: ſo the *Meridian* that paſſeth by that point, ſhal be the houre required. *Conſtructio.21.*

Thus if the day were the tenth of *March*, the *Sun* being that day in the *Æquinoctial*, & the *Altitude* ſuppoſed to be 32 gr.37.m, this I ſeeke out upon the *Index* and move the *Index* till that degree meete with the *Æquator*; ſo the *Meridian* or *houre Circle* that paſſeth thereby is the *houre* viz. 10. of the *Clocke* in the *forenoone* or 2. of the *Clocke* in the *afternoone*, and if you move the *Index* ſoftly along as the degrees of the *Suns Altitude* in the *Index* interſect the *Æquator* ( and ſo of any parallel:) ſo the *Meridian* that meeteth therewith is the *houre* of the day agreeable to that *Altitude*. *Exam.*

## *For the ſecond, to finde the houre of the day agreeable to any Azimuth.* Conſtructio.21.

*As* ſuppoſe it were 36. gr.35. m, from the *ſouth.* *Exam.*

*South.* Move the *Index* in the *Limbe* unto this *Azimuth* known or ſuppoſed; ſo where the *Index* croſſeth the parallel for the day given, there the *Meridian* that meeteth therewith, ſhewes the *houre* of the *day* viz 10. of the *Clocke* in the *forenoone* or 2. in the *afternoone* as before. And if you move the *Index* ſoftly along, as the *Index* paſſeth by any *Azimuth* in the *Limbe*: ſo the edge of the *Index* ſhall interſect the parallel of *declination* for the day of the *Month*, in the *houre* of the day agreeable to that *Azimuth*: by which *propoſition* and the laſt, *Glaſſes* may be eaſily placed to burne according to the *Suns Azimuth*, or *houre aſſigned.*

## Pro. 17. *Fourthly, to finde the ſuns depreſſion, & poſition under the Horizon, at any houre of the night, with the houre of the day to our Antipodes, by ſuppoſing the ſun any number of degrees under the Horizon.*

*Conſtruction.* 23. *By* the 11th Conſtruction it is ſaid that any degree of the *Eclipticke*, is aſmuch belowe the *Horizon* at any time, as his oppoſite degree is above the *Horizon* at the ſame time: therefore if the *Index* be layed to the like parallel, on the contrary ſide of the *Æquator*, that meeteth with the given *houre* the interſection in the *Index* ſhall ſhew you the degree of the *Suns depreſsion* under the *Horizon* at that *houre.*

*Exam.*

*So* if at 10. of the *Clocke* at night the ſaid 13th of *October* it were required to finde the *Suns* dereſſion under the *Horizon*, conſider the *declinatin*, or the *ſuns* parallel for that day, which is 11. gr. nd a halfe *South*, which *declination* I ſeeke in the ther ſide of the *Æquator*, and marke where it neeteth with the *houre* of 10. unto which I lay the *ndex*, ſo the edge thereof in the *Limbe* ſheweth he *ſuns Azimuth* to be nere 42 gr. 30. m, from the *outh*, and the parallels interſection that meeteth vith the *Index*, gives the *Suns* depreſſion, viz. eere 43. gr. and ſo much is the *Sun* below he *Horizon*, and in that poſition the 13th of *Octoer* at 10. of the *Clocke* at night.

But if it were required at what *houre* of the *Night* the *Sun* would touch the verticall Circle f *Eaſt* and *Weſt* under the *Horizon.*

*Conſtructio*, 24.

*Lay* the *Index* to the point of *Eaſt* and marke here about the Contrary pallel meeteth with e *Index*, for there you have both the *houre* and e degree of the *ſuns depreſſion.*

*Exam.*

*So* the day being as before the 13th of *October*, the *declination ſouth* 11. gr. and a halfe, this acount amongſt the *North declinations* & it meeteth ith the *Index* in 38 m, paſt 6. the *houre* of the uns being *Weſt*, and with all the *ſuns depreſſion*, t the ſame time is neere 14. gr. and 50. m.

Pro. 18.

## *Fiftly, to finde the houre of the day to our Antipodes, by ſuppoſing the ſuns depreſſion under the Horizon.*

*Conſtructio.* 25. *Conſider* the *declination* for the day, and mov the *Index* to and fro untill the degree of the *ſun depreſſion* in the *Index*, meeteth with the like parallel or the other ſide of the *Æquator*, ſo th *houre* that meeteth therwith is the *houre* of the da to our *Antipodes*.

*Exam.* *So* if on the 20th. of *Aprill*, we ſhould ſuppoſ the *ſun* to be 13.gr. under the *Horizon*,& deſire t know the *houre* to our *Antipodes*, the parallel o *declention* for that day is 15.gr. *North*, Now in th *Index* account 13. degrees and move it to and fr untill the ſaid thirteenth degree in the *Inde* meete with the 15th. parallel of *South declinatio* ſo the *Meridian* that meeteth therewith is th *houre* of the day to our *Antipodes*, within 2 m, o 9. at night.

Pro. 19.

## *Sixtly, to finde at what houre i any day, the ſuns Azimuch and Altitude will be equall, and how much the Altitude and Azimuth will be.*

*Conſtruction.* *Move* the *Index*, to & fro untill the edge of th

*Inde*

*ndex* meete with the parallel belonging to that ay, in the ſame Number of degrees that the end f the *Index* in the *Limbe* from the point of *Eaſt* oth; ſo have you the degree of the *Suns Azimuth*, nd *Altitude* equall the one to the other, and the *eridian* meeting with the *Index* in the parallel of he given day, ſheweth at what *houre* that *zimuth*, and *Altitude* will be equall.

*So* admit the *ſun* to be in the *Tropicke* of ♋, the *ndex* being moved to and fro untill there be like egrees in the *Index*, and in the *Limbe*, which will e neere 16. gr. 45. m, and there the *houre* that eeteth therewith is 12. m, after 6 in the *forenoon*, t which *houre* the eleventh of *Iune*, the *Suns zimuth*, and *Altitude*, will be *equall* viz. neere 16. r. 45. m, as before. *Exam*

## *Seventhly, to finde what number of dayes any time of the yeare, willmake the day an houre longer or ſhorter.* Pro. 20.

*Account* 7. gr. and a halfe amongſt the *Meridians* from the given day in the *Kallender*, and note the day of the *Month* againſt it, then number the ayes betweene that day and the given day, and you haue the anſwer. *Conſtructio.* 27.

*So* if the day were the laſt of *February*, or the firſt of *March*, conſider the *Suns ſetting* that day by the Inſtrument, which is 40. m, paſt 5. this *doubled* *Exam.*

makes the length of the day, 11. *houres* 20.m, then from the laſt of *February* account 7.gr. and a halfe and it will point out the fifteenth of *March* at which time the Sun ſeteth at 10.m, paſt 6. which *doubled* makes 12 *houres* 20.m, ſo the fifteenth of *March*, the length of the day is an *houre* longer then it was the firſt of *March*; and the difference of time only but 15.dayes, but if the number of daies were accounted to or from the *Suns* entring into the *Tropicall points*, it will be more then 35. dayes before the day will be an *houre* longer or ſhorter.

*Exam.* *So* if from the tenth of *June* we ſhould account 7.gr. and a halfe amongſt the *Meridians* from that *Meridian* that meeteth with the tenth of *June*, it would fall out at the 16th. day of *July*, at which time the day will be an *houre* ſhorter then it was the tenth of *June*, and the intervall of *time* more then twiſe as much as the former viz. 39.dayes.

Pro. 21

## *Eightly, to finde the inequalitie of time, in equall Mounthes or equall number of dayes.*

*This propoſition* at the firſt ſeemes as a *Paradox*, yet by this *Inſtrument* may eaſily be reſolued, and ſo conſequently from *Mathematicall* principles demonſtrated, not onely the inequalitie of equall *Months*, but alſo the inequalitie of *Naturall dayes*.

*Now* a day naturall according to the generall
efinition is one revolution of the *Æquator* or
*rimum mobile*, that is from *ſun riſing* to *ſun*
*iſing*: or it is the time wherein the *ſun* paſſeth by
he *Meridian*, and commeth to the *Meridian*
gaine, commonly taken for 24. *houres*: but be
auſe that in that intervale of *time* the ſun paſſing
rom the *Meridian* and commeth to the *Meridian*
gaine, the *Sun* moves according to his *Naturall*
*notion* (*ſecundum antiquiorum traditionem*)
eere a degree more or leſſe; therefore the *Na-*
*urall day* ſhall be ſomewhat longer or ſhorter
hen 24. *houres*, viz. by ſo much as the difference
f *right aſcention* of that degree of the *Eclipticke*
omes to that the *ſun* is in, and ſeeing the degrees
f the *Eclipticke* amongſt themſelues have not the
ame *difference* of *right Aſcention* that the other
egrees have, (notwithſtanding the degrees of the
*clipticke* amongſt themſelves being equall the
ne to the other) the *ſuns motion* ender thoſe de-
rees being ſometimes quicker, and ſometimes
ower, it will neceſſarily follow that the *ſun* will
nove more or leſſe untill the *ſun* can touch the
*eridian*, which is the limit or tearme of the
*uns diurnall revolution* as before: this difference
nd inequalitie of time in *naturall dayes* may by
alculation be given from day to day, but be-
auſe it is ſo inſenſible little in a day, hardly by an
*ſtrument* of this nature can be ſeene, but by a
umber of dayes, compared with another number
f dayes it will evidently appeare.

*So*, if it were required how much the *Month* Exam.

*of*

of *December* is longer then the Month of *March*, in the firſt of which months the *ſuns motion* is quicker, being about the *Perigeum* then at other Conſtru-ction.28. times, now both of which *months* have equal number of dayes, viz. 31.

| | | | | | | |
|---|---|---|---|---|---|---|
| Finde the right aſcention for the | beginning<br>and<br>ending | of *Mar.*<br>viz. | 350.0.<br>19. 30. | the difer. of right aſcention for the Month of *Mar* is | 29.30. | the difference betweene theſe is 5.gr. |
| | beginning<br>and<br>ending | of *Dece.*<br>viz. | $257.\frac{3}{4}$<br>$292.\frac{1}{4}$ | the difer. of right aſcention for the Month of *Dece.* is | 34.30. | |

which 5.gr. being converted into time by allowing 4 minits to a degree makes about 20. m, and ſo much is the *Month* of *December* longer then the *Month* of *March*, notwithſtanding both of theſe *Months* containing equall number of dayes.

## Pro. 22. *Ninthly, to finde the degree of the Æquator in the Horizon, by ſuppoſſing the degree of the Eclipticke in the Horizon.*

*Notatio.* *If* the degree given be in the *Northerne* part of the *Ecliptike*, the oblique *Aſcention* is leſſe then the right *Aſcention* vel contra. Get therefore firſt the Conſtru-ction.29. right *Aſcention* of the point given by the ſixt Pro. and the difference of *Aſcention* by the 2. Pro. for that taken from the right *Aſcention* gives the degree of the *Æquinoctiall* in the *Horizon*, but if the given degree had beene in a *Southren* ſigne, the difference of *Aſcention* muſt be added to the right *Aſcention*, ſo have you the degree of the *Æquator* in the *Horizon*.

### *Tenthly, to finde the degree of the Eclipticke in the Horizon by ſuppoſing the degree of the Æquator in the Horizon.* Pro. 23.

*This* is but the Conuerſe of the former, onely conſider the correſpondent quarters of the *Æquinoctiall* to theſe of the *Eclipticke*. *Conſtruction.30.*

### *Eleventhly, to finde the degree of Medium Cœli, or the degree of the Eclipticke in the Meridian, by ſuppoſing any degree of the Eclipticke in the Horizon.* Pro. 24.

Seeke the degree of the *Æquator* in the *Horizon*, *Conſtruction.31.*

*rizon*,by the 22. Pro. ſubtract,90.from it (if the Number be too little adde a whole *Circle* to it) then the degree of the *Eclipticke* oppoſite to the remainder,is the Anſwer,but note that if the remainder be betweene 270.and 360. the oppoſite point belongs to the laſt *Quarter* of the *Ecliptike*, if the remainder be betweene 180.and 270.then it reſpects the 3 quarter of the *Eclipticke*, if the remainder be betweene 90.and 180. it hath reference to the ſecond Quarter.&c.

## *But if the degree of the Eclipticke in the Horizon were required by knowing the degree of the in Eclipticke the Meridian.*

*Conſtruction.23.* *This*,is onely but the converſe of the former,& is thus performed firſt,ſeek the right *Aſcentiō* of the given degree of *Medium Cœli*,& adde thereto 90.gr.by accounting it from the former right *Aſcention*,& note the *ſuns* place oppoſit therto for the difference of *Aſcention* of this laſt degree being ſubtracted from the former *degree* of the *Æquator* in the *Horizon*, if it be a degree of the *Southren ſignes*(otherwiſe Adde)gives the degree of the *Eclipticke* in the *Horizon* demanded.

## *Twelſthly,to finde the Horoſcope or the degree Aſcendant,or deſcendant and the Nonageſſima degree at any houre.*

Pro. 25.

Conſtructio,33.

*Firſt*,note the *right Aſcention* for the day given according to the *6*. Pro. which is the degree of the *Æquator* in the *Meridian*, at 12. of the *Clocke*, unto which degree adde 90. ſo have you the degree of the *Æquator* in the *Horizon* at 12. of the Clocke. Then conſider how many *houres* the given *houres* wants of 12. or is paſt 12. which conuerted into meaſure and accounted *Eaſtward*, or *Weſtward*, according to the *houre* given from the former points of the *Æquator* in the *Horizon* at 12. will give the degree of the *Æquator* in the *Horizon* at the *houre* propoſed, then by the 23. Pro. I ſeeke out the degree of the *Eclipticke* in the *Horizō* anſwerable to the degree of the *Æquator* ſo have you the degree *Aſcendant*, from which accouut 90.gr. or 3 *ſignes*, ſo have you the degree of the *Nonageſſima point* in the *Horizon*, but if you reckon 6. ſignes from the *Aſcendant*, you have the *deſendant* degree of the *Eclipticke* in the *Weſt* of the *Horizon*.

# Pro. 26. *Thirteenthly, to finde wha Angle the Eclipticke makes with the Horizon, or the Altitude of the Nonageſſima degree of the Eclipticke, above the Horizon, and what Azimuth it is in at any houre.*

Conſtructio. 34. According to the laſt Pro. finde the degree *Aſcendant*, and *the Nonageſſima* degree, then by the 24. Pro. finde what degree of the *Eclipticke* is in the *Meridian*, Anſwerable to the degree of the *Eclipticke* in the *Horizon*, ſo ſhall you know on which ſide of the *Meridian* the *Nonageſſima* degree is, & how far from the *Meridian*, then if ỷ *Index* be layed upon the *houre* of 12, where the parallel of the *Nonageſſima* degree croſſeth it, that ſhould be the height of it, if it were in the *Meridian*: account therfore from the *Meridian* or houre of 12. in the *Æquator*, the number of degrees betweene the *Nonageſſima* degree, and the degree of the *Eclipticke* in the *Meridian*, & marke where that *Meridian* meeteth with the parallel of the of the *Nonageſſima* degree, lay the *Index* thereto,

ſo

have you the *Altitude* of the *Nouageſſima* degree
the *Index*, and the *Azimuth* in the *Horizon*, or
*imbe* of the *Inſtrument*.

There are yet the 48. 49. 50. 9. 13. 14.
d 15th. uſes of the ſaid *Index* or *Table*, which
aue no relation to the *ſuns* ſight or obſer-
ation in there operation, and reſolutions, and
ould have followed theſe 26. uſes that have
eene delivered: but I referre them to the end of
is *Tractat*; as for theſe uſes of the *Inſtrument*
hich depend upon the *Suns* ſight, or obſervati-
they are theſe 13. following viz. the 1. 31. 4. 6.
6. 7. 22. 3. 5. 34. 11. 43. and 8th.

viz. to ſhew

1. *The Sun, or ſtarres Altitude above th*
*Horizon at any time.*
2. *The houre of the day, and Azimuth of th*
*ſun.*
3. *The Meridian Line upon any appearan*
*of the Sun.*
4. *The ſit of a building, or coſting of a plac*
5. *The Suns Azimuth, and houre witho*
*Obſervation.*
6. *The variation of the Needle.*
7. *The Latitude of a place, or height of t*
*Pole above the Horizon.*
8. *The Suns Azimuth, and Altitude at a*
*houre.*
9. *The uncertainetie of time, by noting t*
*ſhadow of things.*
10. *The Quarter of the yeare and day*
*the Month, with the houre, Azimut*
*and the Meridian line.*
11. *Inſtantly the houre of the day, t*
*Azimuth, and Altitude of the Sun: wi*
*the Meridionall line, without obſervati*
*or ſight of the Sun, by knowing the Pr*
*portion betweene the length of a ſhad*
*upon a Horizontal Plaine, and that whi*
*did caſt the ſhadow.*
12. *The Declination of a Wall, by ſeeing t*
*Sun beginning to ſhine thereon or goi*
*from it.*
13. *The Declination of a Wall, the S*
*ſhining thereon.*

*F*

## *Firſt,how to obſerue the Sun, or ſtarres Altitude above the Horizon at any time.*

Pro. 27.

Conſtruction.35.

*Lift* up the edge of the *Inſtrument* to the eye, ſo that the ſight which is at the *Limbe* or *Circumference* of the *Quadrant* be next the eye,and the *Index* to hang perpendicular and to play eaſily by the ſide therof:then move the *Quadrant* up and downe untill you may through both ſights ſee the *Center* or midle of the *Sun*,or *ſtarre*: ſo the *Index* in the *Limbe* ſhall fall upon the degrees of the *Sun* or *ſtarres Altitude* above the *Horizon* at that time. Or without looking at the *ſun*,the *Altitude* thereof may be thus found: hould the *Quadrant* that the *Index* may hang perpẽdicular,or be *verticall* as before, then move about the *Inſtrument* untill the edge of it be oppoſite to the body of the *Sun*. Now ſuppoſing the *Inſtrument* to hang thus upon his *Center*, ſoftly lift up the edge thereof which is towardsthe *Sun*, untill you ſee the beames of the *ſun* paſſe through both *ſights*, then the *Index* in the *Limbe* ſhall give the *ſuns Altitude* as before.

Conſtruction.36.

*Secondly,*

Pro. 28

## *Secondly, how to finde the houre of the day, and Azimuth of the Sun, upon any appearance of the Sunne.*

Conſtructio. 37.

*By* the laſt *Pro.* obſerue or take the *ſuns Altitude* and account it on the *Index*, then ſeeke for the parallel of the day of the *Month* for the day preſent, & move the *Index* untill that degree of *Altitude* in the edge of the *Index* meete with the parallel of the day, ſo the *Meridian* that meeteth with that degree of *Altitude* in the *Index*, ſhall be the houre of the day required, & the edge of ÿ *Index* in the *Limbe* of the *Inſtrument*, ſhall likewiſe ſhew the Suns *Azimuth* belonging to that houre.

Exam.

*So* if upon the laſt of *Auguſt* the *Suns Altitude* in the forenoone ſhould be obſerued and found to be 30.gr. & a halfe, ſeeke this *Altitude* out upon the *Index* & move the *Index* untill the degree of *Altitude* meete with the parallel for the day of the *Month* given, viz. the fift parallel from the *Æquator Northward* ſo the *houreline* that meeteth alſo with the 30.gr. & a halfe in the *Index*, is the *houre* viz. neere 9. & that ſhall be the *houre* of the day at that inſtant, & the edge of the *Index* in the *Limbe* cutteth neere 35.gr. and 30.m, from the point of *Eaſt*, towards the South, and ſo much is the *Suns Azimuth* at that time.

*Thirdly,*

## *Thirdly, how to finde the Meridian line, and the true points of North, & South, Eaſt, and Weſt upon any appearance of the Sunne.*

*Pro.* 29.

*Conſtructio.* 38.

According to the 27. *Pro.* firſt obſerue the *Suns Altitude* above the *Horizon*, and by the laſt Conſtruction finde the *Suns Azimuth* agreeable to that *Altitude*: let the *Index* and reſt at that degree, and erect the prependicular at the end of the *Index*, then houlding the plaine or *face* of the *Quadrant* parallel to the *Horizon*, move the *Inſtrument Circular*, untill the ſhadow of the ſaid perpendicular fall by the ſide of the *Index*, and ſo the *houer line* of 12, or the edge of the *Inſtrument* which is parallel unto it ( which is the *North* and *ſouth* edge of the *Inſtrument* ) ſhall repreſent the *Meridian line*, and pointeth out the *North* and *South* in the *Horizon* of the world by the termes thereof, and the other ſtraight edge of the *Inſtrument* which is perpendicular unto that edge is the( *Eaſt* and *Weſt* edge of the *Inſtrument*) and denoteth or ſheweth the line of *Eaſt*, and *Weſt* in the *Horizon*, of the world. But this may be more accurately done if you place the backe of the *Inſtrument* downe upon an *Horizontall* plaine, and the edge of the *Index* being at the degree of the *ſuns Azimuth* obſerved, and the perpendicular erected at the end of the *Index* as before: then moving the *Inſtrument* as it ſo lyeth untill the ſhadow of the perpendicular fall by the ſide of the *Index*, ſo the *Meridian* of the *Inſtrument*, ſhall be in the *Meridian* of the World, and every point and degree in the *Limbe* of the *Inſtrument* ſhall point out, and be oppoſite, and repreſent his like degree in the *Horizon* of the world.

*Conſtruction.* 39. But here note that this *Conſtruction* ſerves only but for the forenoone obſervation; for if the practice be in the afternone, the way to finde the *Meridian* line may be thus. Having found the *ſuns Azimuth* as before, lay the *Index* upon the houre line of 12. and erect the perpendicular at the end thereof, and move the *Inſtrument* about *Circular*, untill the ſhadow of the ſaid perpendicular fall by the ſide of the *Index*: for then if the edge of the *Index* be moved unto the *ſuns Azimuth* before known, the edge of the *Index* ſhall repreſent the *Meridian* line, & 90. gr. farther ſhall be the point of *Eaſt*, and the *Center* of the *Inſtrument* the point of *Weſt*, therefore if upon the plaine that the *Inſtrument lies* upon, you make a marke at the edge of the *Index* which is in the *Meridian* as before, and another marke right under the *Center*, and ſo place the *North* and *South* edge of the *Inſtrument* unto theſe two points: then every degree in the *Horizon*.or *Limbe* of the *Inſtrument*,ſhall point out as before his oppoſite or like degree in the *Horizon* of the world.

## *Fourthly, how to finde the ſit of a Building,or Coſting of a place.*

*Pro.* 30.

*By* the laſt *Pro.* finde out or draw the *Meridian line*,and place the *North* and *South* edge of the *Inſtrument* unto it: if the *Building* or *Place* ly in the *Eaſterne ſemicircle* of the world ( but if it ly in the *Weſterne ſemecircle*,then let the *Eaſt* & *Weſt* edge of the *Inſtrument* be placed upon the *Meridian* line)ſo the eye being over the *Center* of the *Inſtrument*,and behoulding the place,let the *Index* be moved untill it be alſo with the viſual line obſerved by the eye,that is oppoſite to the place,ſo the edge of the *Index*, from the *Cardinall* points of the *Inſtrument* in the *Limbe*,viz. from the *Eaſt* or *Weſt*,*North* or *South*,ſhall ſhew the bearing of that place from you, in reſpect of the *Cardinall* points of the world in the *Horizon*:but if two ſights be placed at the *Index* (which is according to the deſcription thereof) then may you obſerve the place through the ſights of the *Index* by leting the *Inſtrument* reſt, and moving the *Index* to and fro untill you ſee the obiect,ſo the edge of the *Index* in the *limbe*,ſhall point out the

*Conſtructio*,40.

bearing or *Poſition* of the place from you in degrees from the *Eaſt*, *Weſt*, *North*, or *South*, & accounting 11.gr. and ¼ as often as you can i thoſe degrees, obſerved: you have the poin of the *Compaſſe* which the place, or obiect beare from you.

Pro. 31.

## Fiftly, to finde the ſuns Azimuth and houre without obſervation.

The *Meridian line* being drawne firſt upon plaine according to the former directions, conſider if it be in the forenoone or afternoone; if i the forenoone, then let the *North*, and *South* edg of the *Inſtrument* be placed unto the *Meridian line* but if it be in the afternoone, then ſet the edge o *Eaſt*, & *Weſt* of the *Inſtrument*, unto the *Meridia line*, and let the *Inſtrument* reſt there, then erect the perpendicular at the end of the *Index*, & mov the *Index* about untill the ſhadow of the perpendicular fall by the ſide of the *Index*, ſo the edge o the *Index* will amongſt the degrees in the *Limb* ſhew the *Suns Azimuth* at that time; and wher the edge of the *Index* meeteth with the parallel o the day of the *Month*, that is the *houre* of the da at that time. *But* if the *Axis* be rectified, then ther is no neede of a *Meridian line* to be drawne, fo this *Inſtrument* will with great facilitie finde ou his owne *Meridian*, by moving it to and fro until

Conſtructio. 41.

the ſhadow of the perpendicular which is ouer the *Center* of the *Inſtrument*, interſect the ſame *houre* in the *Parallel* of the day of the *Moneth*, that the *Axis* doth amongſt the Common *houres*: ſo that *houre* ſhall be the *houre* of the day for that inſtant, and the ſhadow of the ſaid perpendicular, cutting the *Limbe*, or extended unto it, doth there ſhew the Suns *Azimuth*, and ſo the *Meridian* of the *Inſtrument* at that poſition, ſhal be in the *Meridian* of the world required.

## *Sixtly, to finde the variation of the needle.*

*Pro.* 32.

*By* the twentie nineth *Pro.* vpon an even *Plaine* parallel to the *Horizon* draw the *Meridian line*, & place the *North* & *South* line of the *Card* directly over the ſaid *Meridian line*, ſo the Number of degrees that the *Needle* cutteth in the *Card* from the *North* and *South* line of the *Card*, that ſhall be the variation of the *Needle* required; otherwiſe it may be found thus: Neere unto the *Center* of the *Index*, upon the *Index* may a ſmall *Braſſe pinne* be ſo placed that it may be erected perpendicular to the *Center* of the *Inſtrument* and halfe an inch above it. Let a *Needle* by placed upon this pinne, then lay the *Eaſt*, and *Weſt* edge of the *Inſtrument* to the *Meridian line*, & when the *Needle* reſteth, move the *Index*, untill the edge of it be directly under the *Needle* ſo the edge of the *Index*; in the *Limbe* of the *Inſtrument*, ſhall

*Conſtruction.* 42.

point

point out or ſhew the *Needles variation* required.

Pro. 33.

## *Seventhly, to finde the Latitude of a place, or the Poles hight above the Horizon.*

*Conſtruction.* 43.

*First*, draw the *Meridian line* upon ſome plain by helpe of the 38. *Conſtruction*, then erect the prependicular at the end of the *Index*, and plac the *North* and *South* edge of the *Inſtrument*, t the *Meridian line* ſo drawne upon the plaine, an move alſo the *Index* untill the edge thereo touch the houre of 12. let the *Inſtrument* reſt a this poſition, then marke diligently about noon or 12. of the Clocke when the ſhadow of the perpendicular doth fall by the edge of the *Index*, for then the *ſun* is in the *Meridian*, at which tim according to the 27. Pro. obſerve or take the *ſun* height (which is his *Meridian Altitude*, for that day) and by the 3. *Pro.* finde the Suns *declinatio* agreeable to that day, and adde it to the *Sun* *Meridionall Altitude* obſerve (if it be *South declination*, otherwiſe ſubtract it from the forme *Meridionall Altitude*,) ſo have you the height o the *Æquinoctial* above the *Horizon*, that taken from 90. gives the depreſſion of the South *Pole* under the *Horizon*, which is alwayes equall to the elevation of the *North Pole* above the *Horizon*.

*So* if upon the tenth of *Aprill*, the *Meridian* *Exam.* *Altitude* ſhould be found to be 50. gr. the *Declination* belonging to that day by the 3.Pro.is 11. gr.and a halfe *North*, which being ſubtracted (according to the former directions) leaves 38.gr. 30.m, the height of the *Æquinoctiall* above the *Horizon*: & that taken from 90. leaves 51.gr.30.m the depreſſion of the South *Pole* under the *Horizon*: or the elevation of the *North Pole* above the *Horizon*, for the height of the *Æquinoctiall* knowne, the Complement thereof is alwayes the *Latitude* of the place, or height of the *Pole*: and here note generally that the height of the *Pole* and *Æquinoctiall* together, doe alwayes make a *Quadrant* or 90.gr. therefore the height of one of them being knowne, the height of the other is alſo knowne, and further here note that if the *ſun* have *North Declination*, the *ſun* is ſo much higher then the *Æquinoctiall* at none that day, by ſo much as his *Declination* cometh to, but if the *Sun* have South *Declination*, then the *Sun* is lower then the *Æquinoctiall* that day at noone, by ſo much as his *Declination* cometh to, by which you may eaſily gether when to adde, or ſubtract the *ſuns Declination to*, or from the *ſuns Meridianall Altitude* to get the height of *Æquator*, which knowne the *Poles* height cannot be unknowne.

Pro. 34.

## *Eightly, to finde the ſuns Azimuth and Altitude for any houre.*

Conſtru-ctio. 44.

*Marke* where the parallel for the day of the *Month* meeteth with the given *houre*, and bring the edge of the *Index* thereto, ſo the degree that the edge of the *Index* cutteth in the *Limbe* of the *Inſtrument* that ſhal be the *Suns Azimuth*, and the degree that the *houre* cutteth in the *Index*, that ſhall be the *Suns Altitude* required.

Exam.

*So*, if upon the tenth of *December* at nine of the Clocke in the Morning, the *Suns Azimuth* and *Altitude* were required, marke firſt where the *Tropick* of *Capricorne* ( which is the parallel for that day given ) meeteth with the given *houre* of nine, and bring the *Index* thereto, ſo the edge of it in the *Limbe* pointeth out neere 40. gr. and a halfe, & ſo much is the *Suns Azimuth* from the *South*, at nine of the *Clocke* in the forenoone, the ſaid tenth of *December*, and the *houre line* meeting with the *Index*, ſheweth neere 5. gr. 25. m. ſo much is the *ſuns Altitude* at that time; now if you move the *Index* ſoftly along, as the edge of it paſſeth by any *houre* for any day of the yeare, ſo the edge of the *Index* in the *Limbe* of the *Inſtrument* ſheweth the *ſuns Azimuth*, and the interſection of the parallel with the *Index* ſhall ſhew the *Suns Altitude* belonging to that *houre*.

*Ninthly*

# Ninthly, to ſhew the uncertaintie of time, by noting the ſhadow of things. Pro. 35.

*It* is uſually noted by ſome, that when the ſhadow of the edge of a Window, Dore, Wall, or ſuch like, ſhall touch ſuch or ſuch markes, that it ſhall be then ſuch, or ſuch an houre of the day, and ſo conſtantly to hould for all the yeare, this obſeruation is farre from truth, and the principalls of *Aſtronomie* (and may be eaſily contradicted by ſuch which have but indifferent judgement in the Nature of ſhadowes, and the *Suns* paſſages by the *Meridians* and verticall *Circles* of the Heavens, for by how much greater the propinquitie of the *Suns* approchment is unto the *Zenith*, or verticall point, by ſo much the more ſhall the houre or time be various in one and the ſame *Azimuth*.

*So* in the laſt *Pro.* the *Azimuth* of the *Sun* the tenth of *December*, at nine of the *Clocke* in the forenoone, was found to be 40 gr. and a halfe, and the *Suns* diſtance from the *Zenith*, at that time was neere 84. gr. 35. m, Now admitte the *Suns* diſtance from the *Zenith* the tenth of *Iune* were but 32 gr. 35. m, the Sunne being in the ſame *Azimuth*, the houre would be halfe an houre paſt 10. For the *Index* being layed to the *houre* of 9. in the *Tropicke* of ♑. (which is the *Suns* paralell, for the ſaid tenth of *December*,) and it cutteth the **Exam.**

paralell

*Conſtru-ction.45.* parallels of the *Suns Motion* in the inequalitie of time, and ſo the complement of the former 32.gr 35.m, in the *Index*, meeteth with the *Tropicke* of ♋, (which is the *Suns* parallel for the tenth of *Iune*) in halfe an houre paſt 10. ſo that it evidently appeares, that the ſhadow of a perpendicular thing on the tenth of *December*, denoting the *houre* of the day to be 9. of the *Clocke*, the ſame ſhadow the tenth of *Iune*, ſhall repreſent halfe an houre paſt 10. ſo the error ſhall be an houre and a halfe: but if you move the *Index* unto the houre of 9. belonging to the tenth of I*une*, the I*ndex* ſhall point you out in the *Limbe* neere 68.gr. of *Azimuth* for that *houre*, which at 9. of the Clocke the tenth of *December*, was but 40.gr. & an halfe, ſo the difference of *Azimuth* in one and the ſame *houre*, ſhall be 27.gr. and a halfe, & the time as before, an houre and a halfe: which differences are ſufficient to confirme the point.

Pro. 36.

## *Tenthly, to finde the Quarter of the yeare, and day of the month, if it were forgotten.*

*Conſtru-ction.46.* *At* any appearance of the *Sun* by the 27. *Pro* take the *Suns Altitude*, then place the *North* and *South* edge of the *Inſtrument* unto the *Meridian line* formerly drawne (if in the fore noone) otherwiſe place the *East*, and *Weſt*, edge of I*nſtrument* to the *Meridian* *line*,and erect the prependicular at the end of the *Index*, then moove the *Index* to and fro untill the *ſhadow* of the prependicular fall by the ſide of the *Index*,ſo the parallel that meeteth with the degree of the *Suns* obſerued *Altitude*,in the edge of the *Index*, parallel in the *Kalender* that ſhall ſhew the day of the *Month* required.

*So* if, upon a certaine day in the yeare the *ſuns Altitude* were obſerved and found to be 36.gr. having placed the edge of the *Inſtrument* to the *Meridian* line,and rectified the *Index*, then move the *Index*, untill the ſhadow of the prependicular fall by the edge of the *Inſtrument*, let the *Inſtrument* reſt at this poſition, and account the former 36.gr. upon the *Index*, which degree meeteth with the houre in the *Æquator*,and alſo that inerſecteth the *Kalender*,in the tenth of *March*,& he thirteenth of *September*, but which of theſe layes is the day of the *Month*, the next dayes bſeruation of the *Sun* upon the ſame houre will ıelpe you,for if the *ſuns Altitude* be found to be reater then the day of the month inquired after t was the tenth of( *March*, becauſe the *ſun* from he tenth of *December* unto the eleventh of *Iune*, oth every day at one & the ſame houre, aſcend,) ut if the *Suns Altitude* be found to be leſſe then e former dayes obſervation ſpecified was, then e day required, was the thirteenth of *September*, ecauſe that from the eleventh of *Iune*, unto the nth of *December*, the ſuns *Altitude* every day oth ſenſibly diminiſh at one and the ſame houre.

*Exam.*

☞ *But* here is to be noted that if there be r
*Meridionall line*, then the prependicular over tl
*Conſtru-* Center and the *Axis* of the *Index* being erecte
*ctio.47.* place downe the backe of the *Inſtrument* upon
*Horizontall* plaine, and move the *Inſtrument* to a
fro, untill the ſhadow of the *Axis* meete with t
ſame houre below the *Tropicke*, amongſt the co
mon houres, that the ſhadow of the prependicul
over the Center of the *Inſtrument* meeteth wi
on the face of the *Inſtrument*, for then the paral
that croſſeth or meeteth with the *ſhadow* of t
prependicular, and the *houre*, will in the *Kalend*
ſhew the day of the *Month* required, and ſo th
the *Meridian* of the *Inſtrument* ſhall be
the *Meridian* of the world, and every point
degree in the *Horizon* of the *Inſtrument*, it ſh
point out his like, or oppoſite degree in the *H*
*rizon* of the world.

*Conſtru-* Or otherwiſe it may be done thus, take the Su
*ctio,48.* *Altitude*, then immediatly by ſome Watch, cloc
or Sun-dyall, learne the *houre* of the day, and mo
the *Index* to and fro, untill the *Suns Altitude*
the *Index*, meete with the former houre,
the parallel that meeteth therewith, ſhall ſhew
day of the *Month* in the *Kalender* required, th
having the day of the *Month*, you have the *Qu*
*ter of the yeare*, for from the tenth of *March* un
the eleventh of *Iune*, is the *Spring quarter*, fro
the eleventh of *Iune*, to the thirteenth of *Septe*
*ber*, is the *Summer quarter*, from the thirteenth
*September*, to the tenth of *December* is the *Autu*

*uall quarter*, and from the tenth of *December*,
nto the tenth of *March*, is the *Winter*
*Quarter.*

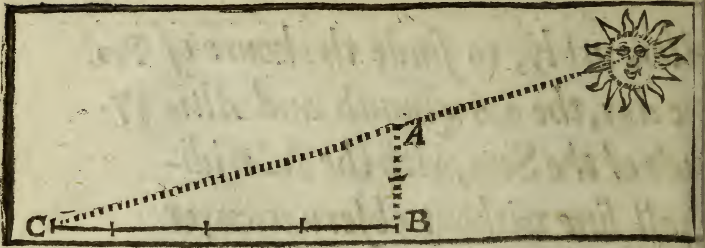
## *Eleuenthly, to finde the houre of he day, the Azimuth and Alti- ude of the Sun, with the Meridinall line without obſeruation, or ſight of the ſun, by knowing the proportion betweene the length of a ſhadow upon a Horizontal Plaine, and that which caſt the ſhadow.*

Pro. 37.

*First*, let the thing that caſteth the *ſhadow*, or
mething equall in length unto it, be divided
to ten equall parts, and each of thoſe parts ſub-
ved into ten other equall parts, (which thing ſo
ivided ſhal repreſent a common *ſcale*,) then mea-
re the ſhadow with the *ſcale*, and marke how
ten the *ſhadow* is longer then the *ſcale*, and the
*ecimall* part if there be any, ſo have you the
roportion betweene the *ſhadow*, and that which
did

*Conſtru-ctio.* 59.

did caſt the *ſhadow*,and then is it reſolved acco
to the conuerſe of the fifteenth Pro.,



*Exam.*

Admit ſome one; upon the 12. of *February*,
on the ninth of *October*, houlding *a ſtaffe* preper
dicular as *A B*, or ſuppoſing it to be part of th
Coyne of a *Houſe*, or edge of a *Window* or ſuc
like ſhould caſt a *ſhadow*, as *B*,*C*, which bein
noted, or drawne and having divided the *ſtaffe*,
thing as before, and ſhould then meaſure the *ſh*
*dow*, as *B*,*C*, by the ſaid *ſtaffe* or *ſcale*, and find
it to be contained therein three times, and 6, part
or 6, decimals, the porportion of the *Gnomon*, o
*ſcale*, *A B*, to the *ſhadow B C*, would be as 1 to 3
and $\frac{6}{10}$.

*Constructio.*
ſo.[illegible]

Move therefore the *Index* to and fro, until
the edge of it meete with 3.and $\frac{6}{10}$, in the line o
*ſhadowes*; ſo have you the degree of the *Suns Alti*
*tude* at that inſtant in the *Index*, viz. 15.gr. and
$\frac{1}{2}$ then ſeeke out the parallel for the 12. of *February*, or the ninth of *October* (the day given)
which is neere the tenth degree from the *Æquator South*, move the *Index*, until the former 15.gr.
and

and ½ in the *Index*, meeteth with the ſaid parallel for the day, ſo have you the *houre* belonging to that time, which will be neere 42 m, paſt 8. in the Morning, or 18. m, paſt 3 in the after noone, and the edge of the *Index* in the *Limbe* of the *Inſtrument* ſheweth the *ſuns Azimuth* alſo at that inſtant, viz, neere 39. gr. 12. m, from the *Eaſt* toward the *South*.

*Now for the Meridionall line*, this may be done at any time after, if the *Azimuth* be not forgotten: for if the Center of the *Inſtrument* be layed downe upon any part of the *ſhadow B C*, and ſo the *Inſtrument* to be mooved upon his Center untill the ſaid *ſhadow B C*, formerly drawne, cut the edge of the *Limbe*, in the aforeſaid *Azimuth* of 39. gr. 30. m, then the *Meridian* of the *Inſtrument* ſhall be in the *Meridian* of the world, and if that *ſhadow* were from a *Window*, or *Building*, the poſition of the *Inſtrument*, ſhall denote the *poſition* of the *Window* or *Building*. *Conſtructio. 51.*

## *Twelfthly, to finde the Declination of a Wall; by ſeeing the ſun beginning to ſhine thereon, or going from it.*

*Pro. 38*

**By** the 27. *Pro.* take the height of the *Sun*, and by the 28. *Pro*, finde the *Suns Azimuth* for the *Conſtruction. 52.*

*Altitude*,ſo the *Azimuth* thus found ſhall be the declination of the *Plaine* required: for the declination of any perpendicular *Plaine*, is accounted from the points of *Eaſt*, *Weſt*, *North* or *South*, in the *Horizon*,as the *Suns Azimuth* is: therefore whatſoever *Plaine* is in the plaine of any *virticall Circle*,that Plaine is as far from any of the Cardinal points of the *Horizon*,as the *ſun* is at that time,& ſo the *Sun*,being in that *virticall Circle*, ſhall neceſſarily glance upon the *Plaine*: and therefore looke what the *Suns Azimuth* is at that inſtant, ſuch ſhall be the *Declination* of the *Plaine* required.

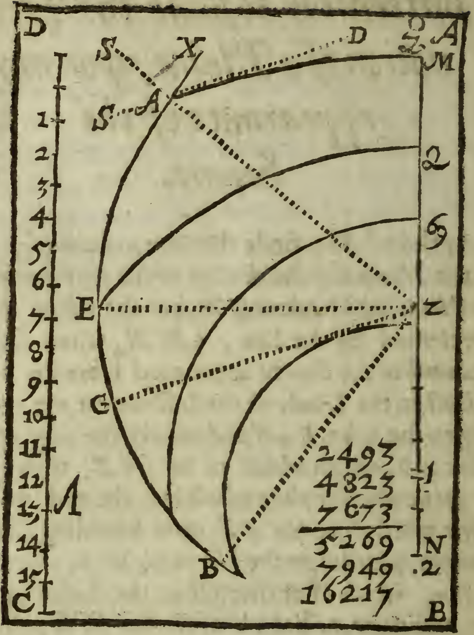
# *Thirteenthly, to finde the Declination of a Plaine, upon any appearance of the Sunne.*

*Pro.* 39.

*Conſtruction.* 53

*By* the 28 .*Pro.* finde the *Suns Azimuth*, and ſet the *North* and *South* edge of the *Inſtrument* to the *Plaine*, which admit *Z* ♑, but the *Plaine* to be repreſented by the line, *M N*. then let the *Azimuth* of the *Sun* be accounted from the point of *Eaſt*, in the *Limbe* of the *Inſtrument*, viz according to the Arke *E A*, and moove the edge of the *Index* to it, which admit to be *A Z*, then erect the perpendicular plate which is at the end of the *Index*, which ſuppoſe *A X*, now houlding the *Inſtrument*, parallel, to the *Horizon*, let *S*, repreſent the *ſun*, which if at that inſtant the *ſhadow* of the perpendicular, or beame of the *ſun* ſhall paſſe by the ſide of the *Index A Z*, then the plaine *M N*, is full *South*, and hath no *declination*, but if the beame of the *ſun*, or *ſhadow* of the prependicular, fall, from the ſide of the *Index* the *Plaine M N*, doth *decline*, and is equall to the Angle made with the ſaid *ſhadow*, and the *Index A Z*, which ſuppoſe to be *A D*, ſo the *Declination* of the *Plaine M N*, is equall to the Angle *D A Z*, therefore moove the *Index* untill the *ſhadow* of the perpendicular of the *Index*, *A X*, fall by the ſide of the

the



the *Index* which will be at *G*, ſo the number of degrees contained betweene *A*, and *G*, in the *Limbe* of the *Quadrant*, is the *declination* of the *Plaine* or *Wall*, *M N*, required.

Thus for the Conſtruction of the aforeſaid 13. uſes which did depend upon the *ſuns obſervation*, the 48.49.50.9.13.14.and 15th.uſes of the *Index* or *Table* againſt Page the firſt, ſhould have followed; but before I ſpeake of them it will not be inconvenient that I apply the *Inſtrument* unto the re-olution of the 44.45.46. & 47. uſes of the afore-id *Index* or *Table*, which have reference to night bſervation, upon ſuch *Starres* which are, or may e placed on the face of the *Inſtrument*, betweene e two *Tropickes*, or under the *Tropicke of Cancer*, cording to there *Declinations*, and *right Aſcenti-s:* which are theſe following.

| *he names the Stars* | *Decli.* G. M. | *Rec:* H. M. | G. M. | *The names of the ſtars.* | *Decli.* G. M. | *Rec.* H. M | G. M. |
|---|---|---|---|---|---|---|---|
| *. Ala Pegaſi* | 13.9. N. | 23.54. | 1. 30. | *Cor Hydræ.* | 7.5. A | 9.10. | 42.45. |
| *i.* ♈. | 21.40. N. | 1.46. | 26.30. | *Cor Leonis.* | 13.45. B. | 9.48 | 33.00. |
| *ulus.* ♉. | 15.42. N. | 4.15. | 63.45. | *Cauda* ♌. | 16.38 B | 11.30 | 7.26. |
| *ſingula. Ori:* | 0. 37. S. | 5.13. | 78.15. | *Spica.* ♍. | 9. 10. M. | 13. 5. | 16.15. |
| *nis maior.* | 16.17. S. | 6.30. | 82.15. | *Arcturus.* | 21.10. B. | 14. 0. | 29.30. |
| *nis minor.* | 6. 9. N. | 7.20. | 70.00. | *Aquila.* | 8. 00. S. | 19.32 | 66.45. |

Much may be ſaid upon the uſes of theſe *ſtarres*, t for brevitie I onely delivere theſe foure ex-ples following.

1. *First*, for any night of the *yeare*, to find at hat *houre*, and *Altitude* any of the ſaid *ſtarres* ill be in the *Meridian*, (that ſo they may be own.)

2. *To know* at any day, at what *houre* any of eſe *ſtarres* riſeth, or ſetteth, with their time of ntinuance above the *Horizon*, and in what part the *Hemiſpheare*, they may be ſeene with their *zimuth*, and *Altitude* at any houre.

3. *Thirdly*, to finde in any night at what part of the *Horizon*, any of the aforeſaid *ſtarres* riſeth, or ſetteth, and at what *houre*, and *Altitude* they will be due *Eaſt*, or *Weſt*.

4. *Fourthly*, upon the ſight or apparance of any of the ſaid *Starres*, to finde the *Azimuth* thereof: and the *houre of the night*.

Pro. 40.

## *Firſt in any night, to finde at what houre and Altitude, any of the aforeſaid ſtarres will be in the Meridian.*

*Conſtructio.* 54. *By* the ſixth *Pro*: finde the *Suns* rigth *Aſcention* for the day given, which conuerted into time by allowing for every 15. degrees an *houre*, and for every *degree* 4.m, then ſubſtract this *right Aſcention* of the *Sun*, from the *ſtarres right Aſcention*, ſo the remainder or difference of time, ſhall ſhew how many *houres* the *ſtarres* ſhall come later to the *Meridian* then the *Sun*: but if the ſubtraction cannot be made, then adde 24. houres to it & **Exam.** you have the *Anſwere*, *ſo*, if upon the ſixth of *February*, it were required to find at what *houre* any of the aforeſaid *ſtarres* will be in the *Meridian* or due *South*, firſt therefore by the ſaid ſixth *Pro* I find the *ſuns right Aſcention* for the day give viz, 330.gr. which containes three nineties o

270

270. each 90.gr. being ſix *houres*, and ſo the whole 270.gr.makes 18.*houres*, and the other 60. gr.at 15.gr. to an *houre* makes 4. *houres* more all which put together makes 22.*houres*: ſo the *right Aſcention* of the *Sun* the ſixth of *February*, is neere 330.gr.as before, or 22. *houres*

| | | H.M. | | H.M. | |
|---|---|---|---|---|---|
| Which 22. houres taken from the right aſcention of the aforeſaid Stars, viz. from. | *Ex. Ala Pegaſi.* | 23.54. | there remaines. | 1.54. P. | the time of the ſtarres being in the *Meridian.* |
| | *Pri.* ♈. | 1. 46. | | 3.46. P. | |
| | *Oculus.* ♉. | 4.15. | | 6. 15. P. | |
| | *Orion ſingu.* I. | 5. 13. | | 7. 13. P. | |
| | *Canis Maior* | 6. 30. | | 8. 30. P. | |
| | *Canis Minor.* | 7. 20. | | 9. 20. P. | |
| | *Cor Hidra.* | 9. 10. | | 11. 10. P. | |
| | *Cor Leonis.* | 9. 48. | | 11. 48. P. | |
| | *Cauda.* ♌. | 11.40. | | 1. 40. A. | |
| | *Spica verginis.* | 13.05. | | 2. 05. A. | |
| | *Arcturus* | 14.00. | | 4. 00. A. | |
| | *Aquila.* | 19.32. | | 9. 32. A. | |

*For* ſeeing that 22. *houres* the *Sunnes right Aſcention*, is greater then the *right Aſcention* of any of the *ſtarres* afore ſpecified, ſubſtract this 22, *houres* from 24. *houres*, reſt 2. *houres*, which added to the *right Aſcention* of each *Starre* before delivered, you have the *houre* of the *Stars* coming to the *Meridian*; hence you may gather which of thoſe *ſtarres*, are out of obſervation for that time, viz. *Ala Pegaſi*, *Pri.*♈, and *Aquila*, which come to the *Meridian* in the day time: but if the day given had been the 26th of *Iuly*, the *right Aſcention* of the *Sunne*, that day is neere 135.gr. or 9.*houres*.

| | | H.M. | | H.M. | |
|---|---|---|---|---|---|
| which 9. houres taken from the right Aſcention of the aforeſaid ſtarrs viz, from. | *Ex. Ala Pegaſi.* | 23.54 | leaves | 2.54.A. | the time of the ſtars cōming to the *Meridian*. |
| | *Pri.* ♈. | 1.46. | | 04.46.A. | |
| | *Oculus* ♉. | 4.15. | | 07.15.A. | |
| | *Orion Singu.* I. | 5.31. | | 08.13.A. | |
| | *Canis Maior.* | 6.30. | | 09.30.A. | |
| | *Canis Minor.* | 7.20. | | 10.20.A. | |
| | *Cor hidra.* | 9.10. | | 00.10.P. | |
| | *Cor Leonis.* | 9.48. | | 00.48.P. | |
| | *Cauda* ♌. | 11.40. | | 02.40.P. | |
| | *Spica Verginis.* | 13.5. | | 04.05.P. | |
| | *Acturus.* | 14.00. | | 05.00 P. | |
| | *Aquila.* | 19.32. | | 10:32.P | |

*For the right Aſcention* of the *Sun* being but 9. *houres* take it from the *right aſcention* of *Cor. hidra* which is 9. *houres* 10. m, reſt 10. m, which ſheweth that *Cor. Hydra* comes to the *Meridian* 10. m, later then the *Sun* that day, that is, 10. m, after 12 and ſo the reſt, whoſe *right aſcention* is greater then the *Suns*. But for theſe *ſtarres*, whoſe *right Aſcention* is leſſe then the ſaid 9. *houres*, ſubtract this 9 *houre* from 24. *houres*, reſt 15. *houre* (or rather ſubtract it from 12. reſt 3. *houres*) this adde unto the *right aſcention* of any of the aforeſaid ſtarres, as ſuppoſe *Canis Minor* makes 22. *houres* 20. m, which ſheweth that *Canis minor*, wil come to the *Meridian*. 22. *houres* 20, m, later that day then the *ſun* : therefore this, 22. *houres* and 20. m, being conſidered according to an hourly account ſheweth, that *Canis Minor* will come to the *Meridian* at 10. of the *clocke* and 20. m: of the next day (the *right aſcention* of the Interuall of time being neglected ) or for brevitie adde the aforeſaid 3. *houres* unto the *right aſcention* of theſe *Starres*, whoſe *right aſcentions* are leſſer then the *Suns*, ſo have you the *Meridionall houre* required.

Hence may be gathered that *Ala Pegaſi*, *Pri.♈* and *Aquila*, are onely for obſervation that night, the other *ſtarres* are out of obſervation, and will come to the *Meridian*, in the day time.

*Laſtly, to finde the Meridionall Altitude of any of theſe ſtarres*, lay the edge of the *Index* unto the *houre line*, of 12, ſo the parallel of the *ſtarres declination* that croſſeth the edge of the *Index*, ſhall there ſhew you in the *Index*, the *Meridionall Altitude* of the *ſtarre* required.

Pro. 41.

## *Secondly, to know at any day, at what houre any of the ſtarres (inſcribed on the Inſtrument) riſeth or ſetteth, with their time of continuance above the Horizon, & in what part of the hemiſpheare, they may be ſeene, with their Azimuth, and Altitude at any houre.*

Conſtru ctio. 55. *By* the laſt direction finde the *houre* of the *ſtars* being in the *Meridian*, then marke what houre the parallel of the *declination* of any *ſtarre* interſecteth the *Horizon* or *Kalender*, ſo have you the *houre* or time of the *ſtarres riſing* or *ſetting*, and the number of *houres*, from that point of the *ſtars riſing* in the *Horizon*, unto the *Meridian* being doubled, gives the countinuance of the *ſtarres* above the *Horizon*, required.

Exam. *So* if upon the 6th. of *February*, it were demanded at what *houre Oculus* ♉. would aſcend, & how long it would continue above the *Horizon*.

*By* the laſt propoſition, get the *houre* of the *ſtarres* being in the *Meridian*, which is at 6. of the Clocke and 15. minuts at night, and marke the Number of *houres* betweene the *Meridian*, and that point where the parallel of *Oculus* ♉, meeteth with the *Kalender*, which is 7. *houres* 24, minuts, this doubled makes 14. *houres* 48.m, and ſo long will *Oculus* ♉, be above the *Horizon*.

*But* if from the ſaid 7, houres and 24. m, the ſaid 6, houres 15.m, be taken, there will reſt 1. houre 9.m, and ſo much before 12. of the clocke at noone, doth *Oculus* ♉ riſe, that is 51.m, after 10, of the Clocke, and ſo conſequently if the ſaid 7. *houres* and 24.m, be added unto the houre of the *ſtarres* being in the *Meridian*, viz. 6. of the Clocke and 15. m, as before, the ſaid *ſtarre* will ſet at 39.m, paſt 1, in the *Morning*.

Laſtly, if at any *houre* betweene the *riſing* of the *ſtarre*, and the *ſetting* thereof, it be required at what *Poſition* and *Altitude* the *ſtarre* is in. It is thus done.

*Conſtruction. 56.*

*Account* to the given *houre*, from the *houre* of the *ſtarre riſing, ſetting*, or being in the *Meridian*, (in the parallel of the ſtarres declination) and lay the *Index* thereto, ſo the edge of it in the *Limbe* of the *Inſtrument*, ſhall ſhew the *ſtarres Azimuth* or *Poſition*, and where the parallel of the ſtarres *Declination* croſſeth the edge of the *Index*, that ſhall be the *ſtarres Altitude*, at that *houre*.

*Exam:*

*So* if no the ſaid 6th. of *February*, at 11. of the *Clocke* at night, if it were required in what *Poſiti-*

*on*, or *Azimuth Oculus* ♉, was in, and alſo how high above the *Horizon:* I make, or ſuppoſe the *houre* of 12. to be the aforeſaid 6. of the Clocke and 15.m, (for at that *houre* as before *Oculus* ♉ was in the *Mridian*) and from thence in the *ſtars* parallel of *Declination*, I account untill I come unto 11. of the *Clocke*, viz. that is 4. *houres*, and 45.m, from 12. and lay the *Index* thereto, ſo the edge of the *Index* in the *Limbe*, pointeth out 4.gr: 24.m, and ſo farre *Oculus* ♉, is diſtant from the *Weſt* at 11. of the *Clocke* at night, and the parallel of the *ſtarres Declination* meeteth with the *Index* in 24.gr, neere, which is the ſtarres *Altitude*, at that *houre* required.

## *Pro. 42.* *Thirdly, to find in any night of the yeare, in what part of the Horizon any of the ſtarres on the inſtrument riſeth or ſetteth, and at what houre, and Altitude a ſtarre will be due Eaſt, or Weſt.*

*Conſtruction. 57* *For the firſt*, *Marke* where the parallel of the *ſtarres declination* croſſeth the *Horizon*, or *Kalender*, Lay the edge of the *Index* hereto, ſo the number of degrees betweene the edge of the *Index*, and the point of *Eaſt* or *Weſt*, upon the *limbe* of the *Inſtrument*, ſheweth the diſtance of the *ſtarres riſing* from the *Eaſt* or *Weſt*.

Exam.

*So* if it were required in what part of the *Horizon Oculus* ♉ riſeth, marke where the parallel of the *ſtars Declination* croſſeth the *Horizon*, and lay the edge of the *Index* thereto, ſo it cutteth the *Limbe* of the *Inſtrument* from the *Eaſt* neere 26. gr. and ſo farre *Oculus* ♉, riſeth from the *Eaſt* owards the *North*.

*For the ſecond to finde the time of a Starre coming Eaſt, or weſt.*

Conſtructio. 58.

*By* the 40th. *Pro.* conſider at what houre the *Star* s in the *Meridian*, then lay the edge of the *Index* o the point of *Eaſt* and *Weſt*, and account in the arallel of the *ſtars Declination* the number of *oures* betweene the edge of the *Index*, and the *oure* of 12. which being taken from the *houre* of he *Stars* being in the *Meridian*, gives the *houre* f the *ſtars* coming *Eaſt*, but added unto the *houre* f the *ſtars* being in the *Meridian*, ſhewes the *oure* of the *ſtars* being *Weſt*.

Exam.

*So* if it were demaunded at what *houre*, upon he 6th. of *February*, Cor ♌, would be due *Eaſt* or *eſt*, and what *Altitude* the ſtarre ſhould then ave. Firſt, lay the edge of the *Index*, to the oint of *Eaſt* and *Weſt*, & whereſoever the parallel f the ſtarres *declination* croſſeth the edge of the *ndex* that ſhall be the ſtarres *Altitude*, viz. neere 7.gr 45.m, then account the number of *houres* in the parallel of the ſtarres *Declination* between the edge of the *Index*, and the *houre* of 12. whic is neere 5. *houres* and 12. m, which taken from th *houre* of the ſtarres being in the *Meridian*,) whic by the 40th. Pro. was at 11. of the *clocke* & 48. m, night) reſts 6. *houres*, and 36. m: but if the ſaid 5 *houres* and 12. m, be added unto the ſaid 11. *hour* and 48. m, it makes 17. *houres*, from which 12 being taken leaves 5, *houres*. So upon the 6th. o *February*, Cor ♌ ſhall be due *Eaſt*, at 36. m, paſ 6, at night, and due *Weſt*, at 5, of the Clocke i the Morning, and the *Stars Altitude*, being eith *Eaſt* or *Weſt*, is neere 17. gr. 45. m, as was re quired.

## Pro. 43. *Fourthly, upon the ſight or appearance of any of the aforeſaid ſtars to finde the Azimuth thereof, and the houre of the night.*

*By* the 40th. Pro. for the day given finde the
*Conſti u* *houre* of the *ſtarres* coming to the *Meridian*,
*ℰtio.* 59. then by the 27. Pro. take the *ſtarres* height, and account that height in the *Index*, then move the *Index* untill the degree of the *ſtarres Altitude*, in the *Index*, meete with the parallel of the *ſtarres Declination*, ſo the edge of the *Index* in the *Limbe*

ſheweth

ieweth the ſtarres *Azimuth*, and the *Meridian*
hat meeteth with the degree of the *Altitude*, in
he *Index* ſhall ſhew you the *houre* that the *ſtarre*
ants to be in the *Meridian*, or is paſt the *Meri-*
*ian*, which added, or ſubtracted from the *houre*
f the *ſtarres* being in the *Meridian*, gives the
*ure* of the night required.

*So* if the day were the 26th. of *Iuly*, and if *Exam.*
*qnila*, ſhould be obſerved to be on the *Weſt* of
e *Meridian*, 29.gr.20.m, high above the *Hori-*
*on*, this I ſeeke out upon the *Index*, and move
he *Index* to and fro untill the ſaid, 29.gr.20.m,
eete with the parallel of *Declination*, of *Aqnila*,
the edge of the *Index*, in the *Limbe* doth point
ut the *ſtarres Azimuth* from the *South*, viz. 63.
r.12.m, and the *Meridian* that meeteth with the
foreſaid degree of *Altitnde*, is the time of
he *ſtarres* diſtance from the *Meridian*, viz.
eere 3. *houres* and 28.m, this added unto the
*oure* of *Aquilas* being in the *Meridian*, which
y the 40th. Pro. was at 10. of the Clocke & 32.
n, at night, makes 14. *houres*, or 2 of the *Clocke*,
n the *Morning*, ſo if *Aquila* were obſerved the
6th. of *Iuly*, to be 29.gr.20.m, *high* to the *Weſt*
f the *Meridian*, then the *Poſition* or *Azimuth* of
hat *ſtarre* from the *Meridian*, was 63.gr.12.m,
nd the *houre* at that inſtant, was at 2. of the
Clocke in the Morning.

*Thus* touching the reſolution of the aforeſaid 44.45.46.and 47th. *Pro.* of the aforeſaid *Inde* or *Table*, which did belong to *Aſtronomicall* obſeruations, the laſt uſes now follow, viz. 48.49 50.9.13.14.and 15th. uſes of the *Index* or *Table* which are onely proper to *Geometricall Practice* viz.

to ſhew

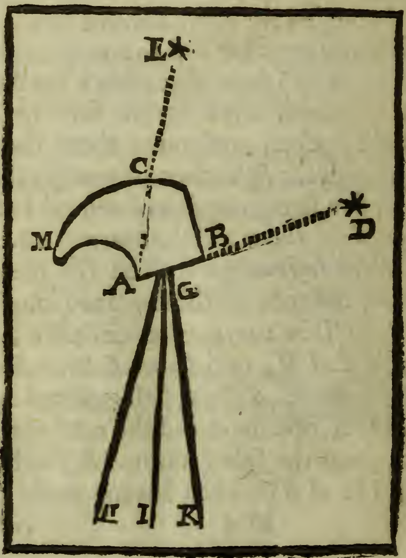
1. *How to meaſure the Quantitie o an Angle, or to take the diſtance of tw Starres.*
2. *How to meaſure diſtances and bredthe*
3. *How to take the Circuit of a figure, o the ſurueigh of a Place:*
4. *The inclination of a Plaine, or to Plac a Plaine Horizontall.*
5. *Whether an Altitude be in the Point o libration, or above, or below the level of the eye, and how much.*
6. *How much the hight of an Altitude is above the eye, which is acceſſable, or inacceſſable.*
7. *How to meaſure any Part of an Altitude, which is not approachable.*

# Firſt, how to obſerue or finde the meaſure of an Angle, or take the diſtance of two ſtarres by the Inſtrument. Pro. 44.

Conſtruction 60. *Let* the *Iſtrument* be placed upon ſome *Reſt*, hich may be ſo accommodated that the *Inſtrument*, may be elevated, depreſſed, or be placed *Horizontall*, as occaſion requires, then erect the ghts of the *Index*, & place the edge of the *Index* pon the houre line of 12. the *Index* ſo placed ooke through the *ſights* thereof and moving e *Inſtrument* upon his *Reſt* to and fro, untill you e the marke or *Starre*, that makes the Angle or iſtance required. Then ſcrew faſt the *Inſtrument* to the ſocket, and move about the *Index*, ntill through the *ſights* thereof you ſee the other arke or *ſtar*, ſo the number of degrees betweene e edge of the *Index* and the *houre* of 12. in the *imbe* of the *Inſtrument* ſhall be the meaſure of Angle, or diſtance of the *two Stars* ſought for.

Exam: *Let E* and *D* be two markes or *Starres*, and let e Angle *E A D*, or diſtance *E D*, be required. he *Inſtrument*, *A B M*, being placed upon his *eſt G H I K*, obſerue one of the markes or *ſtarres* *D*, through the *ſights* (admit *A B*,) ſo the viſuall ne ſhall be *A B D*, then having made faſt the

*Inſtrument*, move the *Index A B*, untill throug the *ſights* of it you ſee the other marke or *ſtarr* *E*, which ſuppoſe to be in the viſuall line, *A C* ſo the Arke of the *Limbe* of the *Inſtrument B C* ſhall be the diſtance betweene the two *Stars*, *ƐD* *Corollarie.* or the meaſure of the Angle *Ɛ A D*, require Now Infinit are the uſes of knowing th Quantitie of *Angles*, in the Copious and va Body of *Mathematicall* Practices, therefore fro the multitude of *Examples* that might be raiſe upon them, or extracted from them, I will onel inſtance for brevitie, upon theſe two plaine, an ordinary ones following.



# Secondly, how to meaſure diſtances, and Breadths.

Pro. 45.

Exam.

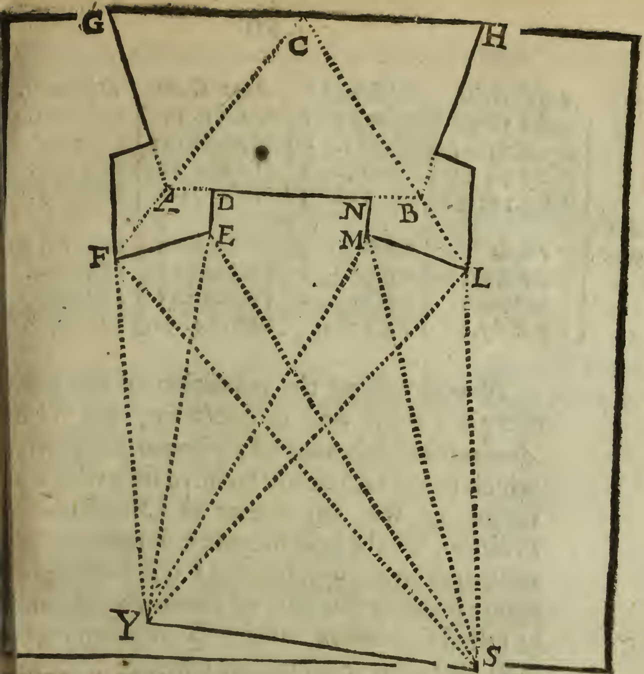
*Let O F L H*, repreſent part of the *Perimeter* of a *Fort*,and let it be required, that ſtanding at ome convenient place without *Musket* ſhot, as dmit at *Υ*, the diſtance betweene the points of he *Bulwarke* viz.*F*& *L*,as alſo the meaſure of the ace of either of the *Bulwarks* viz. *F E*, or *M L*, vith the length of the *Cortaine D N*, and all the liſtances from *Υ*, viz; *ΥF*, *Υ E*, *Υ M*, and *Υ L*, vere required.

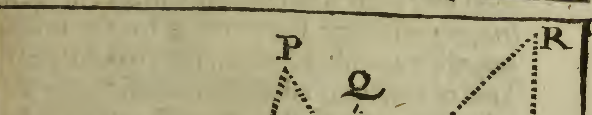
*Or ſuppoſe O P Q R*,were 4 places, whoſe ſeverall diſtances the one from the other as from O to *P*,then from *P* to *Q*,and from *Q* to *R*,&c. o the ſeveral diſtances from *Υ* viz.*ΥO*,*ΥP*,*ΥQ* nd *Υ R*, were demanded. The *Conſtruction* and eſolution upon either of theſe is alike,therefore ve will inſtance upon the latter.

Conſtructio.61.

*Place* the *Inſtrument* upon his *Reſt*,at *Υ*,and the dge of the *Index*,upon the *houre* of 12.then looking through the *ſights* of the *Index*, upon ſome narke taken at pleaſure in the field,which, admit o be *S*, then obſerve the firſt marke *R*, ſo have ou the Angle *S Υ R*,which ſuppoſe 52.gr.30.m, en looke to *Q*, ſo have you the Angle *SΥQ*, hich let be 63.gr.15.m, then looke to *P*, ſo ave you the Angle *SΥP*,admit to be 74.gr.15.m, d laſtly looke to *O*, ſo have you the Angle *SΥO*, *S Y O*, 123.gr.15.m:for theſe Angles are tak with great facillitie, when once the *Inſtrnme* is rectified as in the firſt direction is ſpecified,f you neede not but move the *Index*, *Circular* fro obiect to obiect,ſo the Arkes of the *Limbe* the *Inſtrument* as before, from the *houre* of 1 unto the edge of the *Index*, ſhall ſhew t meaſure of the ſeuerall Angles obſerved.

Thus at *Y*, place up a Marke,and in the viſua line, *Y S*, and meaſure a certaine diſtance pleaſure,as admit to *S*,and ſuppoſe it were foun to be 900. foote (or 300.yardes) then placin the *Inſtrument* at *S*, upon his *Reſt*, and layin the edge of the *Index* to the *houre* of 12. move the *Inſtrument* about, untill through th *ſights* of the *Index* I may ſee the marke whic was ſet up at my laſt *ſtation*, then make faſt th *Inſtrument*,and obſerve *O*, ſo have you the Angl *Y S O*, which ſuppoſe to be 26.gr.50.m, the looke to *P*, ſo have you the Angle *Y S P*, whic let be 55.gr.50.m,then looke to *Q*,ſo have yo the Angle *Y S Q*,which admit to be 60.gr. 15. m, laſtly obſerve *R*,ſo have you the Angle *Y S R*, 87.gr. In like maner may you obſerve the Angles at the *Fort* from the ſtations *Y*, and *S*, formerly ſpecified all which *obſervations* may be placed downe in *Tables*, as here under appeares, which may be called the *Tables* of obſerved Angles.


G
C
H
A
D
N
B
F
E
M
L
Y
S


P
R
Q
O
Y
S

| | *Ang: G.M.* | *Distances* | | *Ang: G.M.* | *Distances.* |
|---|---|---|---|---|---|
| *Y S.*<br>990. | *RYS*.52.30 | *SR*.1999. | 5 | *SYL*.55.45. | *SL*.1071. |
| | *QYS*.63.15 | *SQ*.963. | 6 | *SYM*.68.15 | *SM*.1182. |
| | *PYS*.74.15 | *SP*.1132. | 2 | *SYE*.89.10. | *SE*.1364. |
| | *OYS*.123.50 | *SO*.1526. | 1 | *SYF*.104.00 | *SF*.1459. |
| | *YSO*.26.50. | *YO*.829. | 2 | *YSF*.39.15. | *YF*.971. |
| | *YSP*.55.50. | *YP*.973. | 2 | *YSE*.49.35. | *YE*.1039. |
| | *YSQ*.60.15. | *YQ*.937. | 0 | *YSM*.66.45. | *YM*.1169. |
| | *YSR*.37.00. | *YR*.1384. | | *YSL*.79.30. | *YL*.1268. |

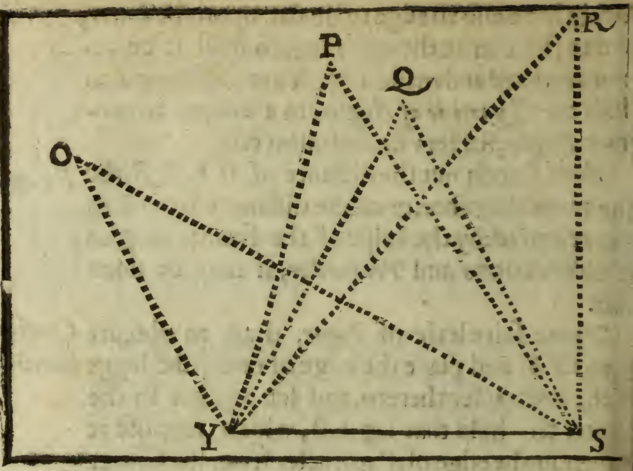
*Now* touching the reſolution of the poin there is a triple way of operation, viz. eith *Arithmeticall*, *Inſtrumentall*, or *Geometricall*, each which being ſufficiently facill, to ſuch which a verſed in the documents of *Mathematic* *Practices*, but the later becauſe it is more vulga and eaſieſt to be apprehended, I will inſtance he upon: which is that part of *Geometrie*, commo ly called *Protraction*, a thing ſo common that a moſt every one that hath any entrance in *Geom* *trie*, can performe it according to the ordina way they are inſtructed in. But to facilitate th kind of practice, I aduiſe ſuch as affect this kin of Practice to uſe the *Protracter*, which I uſ which is a plaine then *ſector*, having a ſmal hole the *Center*, whoſe two legges from the *Center* a made with a ſharpe edge, but ſo that they lie fl upon the *Paper*, & each of them to be divided in 100 or 1000 diuiſions with a *Quadrantall Ar* or more divided and faſtned alſo at the end one of the leggs, but ſo that the *Quadranta*

*Ar*

*Arke* have alſo an edge to lie flat upon the *Paper*,
nd to ſlide in at the other leg, ſo ſhall it be ac-
ommodated and made a fit, & apt *Inſtrument* to
inde the *Quantitie of Angles*, in a *Plot*, or to pro-
ract *Angles*, for ſervice, as followeth.

*So* to ſearch out the diſtance of *O P Q R*, the *Exam.*
ne from the other, or all the diſtances from *Y* as
as required: by the helpe of the former Angles
f obſervations and *Protracter*, it may be done
us.

*Upon* a faire leafe of *Paper*, draw an obſcure *Conſtru*
ne as *Y S*, and place the edge of one of the leggs *ctio.62.*
f the Protracter thereto, and ſet a pinne in the
enter to hold that leg faſt, which ſuppoſe at
,then in the edge of, Protracter from the Center
e account, 90°. & make a point upon the *Paper*,
nto which write *S*, then account. 52. gr. 30. m, in
e *Quadrantall Arke* (which is the Angle *RYS*,
ecified in the aforeſaid Table of Angles) and
ove the edge of the other leg of the *Protracter*
to it, and by that edge draw the line *Y R*, then
count 63. gr. 15. m, in the ſaid *Quadrantall*
*rke*, and move the former legge, unto it, and
aw the line *Y Q*, In like manner may you ac-
unt the reſt of the Angles out of the aforeſaid
*ble of Angles* in the former *Quadrantall Arke*,
d ſo draw the other lines *Y P*, and *Y O*. Laſtly,
the Center of the *Protracter* upon *S*, and the
ge of one of the leggs thereof upon the line
*Y*, then in the *Quadrantall Arke* account 26. gr.
.m, which is the Angle *Y S O*, as is before ſpe-



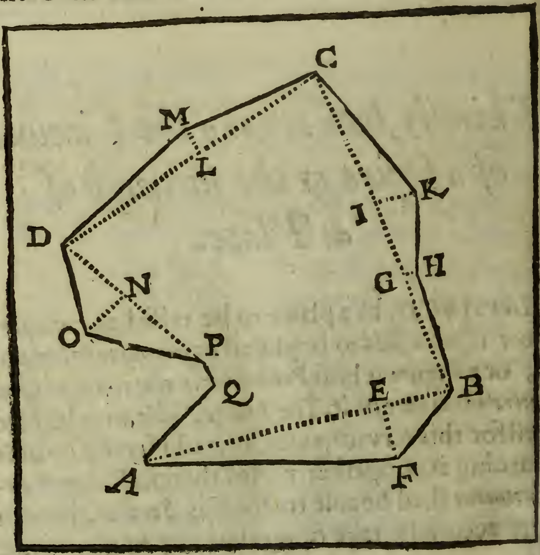
cified in the *Table of Angles*, and lay the edge
the other legge of the *Pretractor* unto it, a
draw the line *S O*. Now marke whether the li
*S O*, meets with the line *Y O*, which will be at
ſo *S O*, ſhall be one of the diſtances required, a
ſhall be meaſured or given in the edge of the *P*
*tracter*, to be 1526,1 foot. In like manner accou
55.gr.50.m, in the *Quadrantall Arke*, which
the Angle *YSP*, and move the edge of the *P*
*tracter* to it, and draw the line *SP*, and alſo mar
where the edge of the *Pretractor* meets with t
line *YP*, which will be at *P*, ſo *P S*, ſhall be an
ther diſtance, and alſo meaſured in the ed
of the *Pretractor* as before, viz. 1132. foot
*In like maner* may you *Pretract* the other Angl

and ſo alſo draw the reſt of the lines, *S Q*, and *S R*, then laying the Center of the *Protracter* upon *Y*, and one of the edges being moved to any line, would inſtantly ſhew you the meaſure of that line which is the diſtance required viz. *Y O*, 8292. *Y P*, 9732. *Y Q*. 937.0, and *Y R*, 1384. foote and theſe meaſures with the reſt are placed oppoſite to each Angle, in the aforeſaid ſpecified *Table of Angles*: now if you place the Center of the *Protractor* upon *O*, and move one of the leggs to *P*, ſo have you the bredth *O P*, in the edge of the *Pretracter*, and ſo of others: Thus for the firſt example upon the uſe of Angles in Bredth and Diſtances, the ſecond followeth:

## *Thirdly, how to take the Circuite of a figure, or the ſurveigh of a Place.* Pro. 46.

*Let ABCD*, be a plaine to be raiſed as *Fortifiers* ave it, or a *field* to be ploted as *ſurveyers* account t, or a *Figure* whoſe *Perimeter* is required, as *Geometritiãs* treate of it. The *Plaine Table*, may be held eſt for this ſervice, as ſuch would have it, whoſe earning is altogether verſed therein. But any *Inſtrument* ſhall be able to doe this *Service*, that can ut accuratly take or meaſure any Angle, ( not Exam. Notatio.

that we reject that, but make uſe of this for the preſent ) and therefore in this action, it were no loſſe of time to make a preambulation about the field, to view the ſeverall windings and turnings thereof, and what *Angles* with greateſt Conveniency, and expedition are to be obſerved, and what might be omitted, and at the *Angles* of conſequence there to ſet up ſome marke, and upon thoſe *Angles* to fabricate the whole worke: for here eſpecially is to be noted, that the more *Angles* that are obſerued in any practiſe, by way of Circumſcribing a *Field*, or *Campaigne*, the greater, and more evident ſhall the error be in the Concluſion.



*So* in the *Figure A B C D*, there is eleven *Angles* and as many ſides, now if at every *Angle*, an obſervation ſhould be made,it would be more ſubiect to error ( as before ) then if leſſe *Angles* were obſerved,therfore in this *Diagramme* fewer *Angles* of obſervation may be fully ſufficient to raiſe that *Plaine*, Take the *Plot* of the *Field*, or give the *Perimeter* of that *Figure*, Therefore ſuppoſe the noted *Angles* of Conſequence to be, *A*, *B*, *C*, *D*, *Q*, the worke may be then thus. *Exam.*

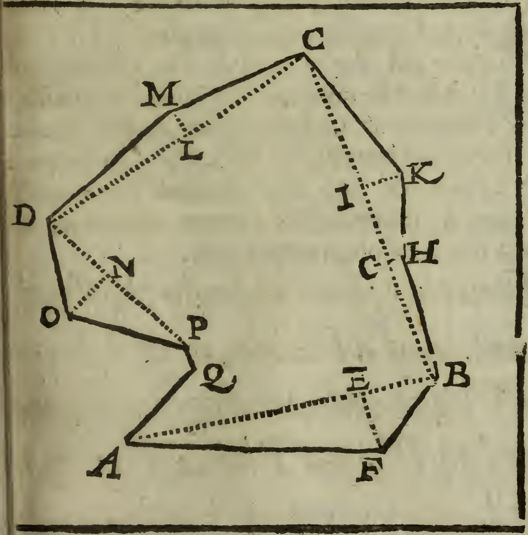
*Place* the *Inſtrument*, upon his reſt at *A*, and obſerue the *Angle Q A B*, which ſuppoſe 32.gr.10 m,then meaſure *Q A*, with a *Decimall* Chaine(or ſuch like,) which ſuppoſe to be 5.Chaines,note this in a peece of paper, then take the *Inſtrument* up,and meaſure the line, *A B*, but firſt onely *AE* ,which ſuppoſe to be 11. Chaines and 60 Linkes,which is written down thus,11.60.Then neaſure the diſtance from *E* to the Angle *F*, vhich admit to be 2. 20,Laſtly, go one with the neaſure *A B*,which ſuppoſe to be 15. 00, the ngle of obſeruation, and meaſures thus taken nay be noted downe one againſt another, as in he *Table* following, then place the *Inſtrument* pon his reſt at *B*,and obſerue the Angle: *ABC*, hich note downe alſo and meaſure the diſtance, *G*,and *G H*,and then going on with *G B*,to *G I*, nd marke and meaſure *B I*,and then meaſure alſo *K*,and ſo goe on with *B C*, which *meaſures* are l placed down as appeares in the *Table* of *Angles* and *Conſtruction 63.*

and meaſures following: In like maner performe the reſt of the worke untill you come to Q, and ſo all the *Angles* and *meaſures* will be according to the *Table* here under ſpecified.

| *The Table of Angles:* | *The Table of meaſures.* |
|---|---|
| G.M.<br>32.10. | 5.00. |
| | 11.60. |
| | 2.20. |
| | 15.00. |
| 80.10. | 6.00. |
| | 1.00. |
| | 9.20. |
| | 2.00. |
| | 16.40. |
| 79.30. | 6.90. |
| | 1.20. |
| | 8.00. |
| 74.45. | 3.70. |
| | 1.15. |
| | 5.40. |

*Having* theſe obſervations and meaſures, they nay be *Protracted* thus: upon a faire ſheete or eaſe of *Paper*, draw an obſcure line as *A B*, and lace the edge of the *Protracter* thereto, then eeping the edge of the *Protracter* faſt upon the ine *A B*, open the other edge to an *Angle* equall o *B A Q*, viz. 32. gr. 10. m, then place the pine in he *Center*, & make a marke at *A*, and account in heedge of the *Protracter* the meaſures of the lines *Q, AE, AB*, out of the Table of meaſures, and nake markes with a pin, or ſuch like at the terms herof. viz, at *QE*, & *B*, then open the *Protracter*, t a right *Angle*, & place the *Center* upon *E* & one e edges of it upon the line *AE*, ſo the meaſure of f the line, *E F*, may be accounted in the edge of e *Protracter*: then draw apparently *AF*, & *FE*,

*Conſtru-ction.64.*



O

ſo have you *Protracted* a part of the *figure*,then l
the *Center* of the *Protracter* upon *B*, and one
the edges upon the line *B A*,and open the oth
edge unto 80.gr.10.m, according to the *Ang*
*ABC*, then in that edge out of the former *Ta*
account from the *Center B*, 6.00 and make
point at the terme therof,which admit at *G*,th
account 9.20.and at the end of it make anoth
point,which admit *I*, laſtly, in the edge of t
*Protracter* account 16.40. and at the end of
make a point,which ſuppoſe *C*, and according
the former directions *Protract* alſo out of t
*Table* of meaſures, the meaſure for *G H*, and *I*
then laſtly draw apparntly, *B H*, *H K*, and *K*
In like maner may you *Protract* the reſt of t
*Angles*,and meaſures out of the aforeſaid *Table*
*Meaſures* and *Angles*, and ſo the whole *Plai*
*A B C D*,ſhal be raiſed,or the ſaid field *Plotted*,
the *Perimeter* of the figure given,as was requir

But it had beene fully ſufficient (by helpe
this *Protractor* ) to have plotted the aforeſa
*Plaine*, by knowing the former *Meaſures*, a
two Angles of obſeruation only.

Pro; 47.

## *Fourthly, how to finde the Incl nation of a Plaine, or to Eleva a Plaine unto an Angle aſſigne and to Place a Plaine Horizon tall.*

Conſtru-ctio.65. *For the firſt*,Set the *Eaſt* and *Weſt*, edge of t

*Inſtrument* unto the *Plaine*, then if the edge of
he *Index* in the *Limbe* of the *Inſtrument*, cut
he point of *Eaſt* or *Weſt*, the *Plaine* is *verticall*,
nd doth not *Incline*; but if the *Index* fall from the
oints, looke how many degrees it is from the
oints of *Eaſt* or *Weſt* in the *Limbe* of the *Inſtru-*
*ent* ſo much is that *Inclination* of the *Plaine*.

*For the Second, to Elevate a Plaine, to an Angle*
*ſigned.*

*This* is onely the ſame with the former, but
ay be applyed to ſeverall uſes, as to trie the
ount, or to mount a *Peece* of *Ordinance* at any
*andon*: or to place *Burning glaſſes* ( or others )
ſeverall Angles, to receive each others *Reflex-*
, and that the point of concurſe, or *inflammation*
ſuch *Glaſſes* may be in the *Radius* or beame of
e *Sunne*, or that the point of *inflamation*, the re-
eſentative *Image*, or the extenſive *Elumin-*
*on* may be proiected to a point aſſigned.

*For the Third, to rectifie a Plaine Horizontall.* *Conſtru-*
*Place* the *North* and *South* edge of the *Inſtru-* *ctio.66.*
*nt*, unto the under face of the *Plaine*, and then
rke if the edge of the *Index*, cut the points of
*ſt* or *Weſt* in the *Limbe* of the *Inſtrument*, for
n the *Plaine* is *Horizontall*, but if it ſwarue
m that point, then it is not *Horizontal*, but the
*ine* is to be raiſed, or depreſſed, untill by ſeverall
alls in ſundry parts of the *Plaine*, you ſee the
ge of the *Index* fall upon the points of *Eaſt* or
*ſt*, for then ſhall it be truly *Horizontall*: Other-
ſe you may rectifie the *Plaine Horizontall*, by
erating upon the upper face of it, if you ſet a

*Cube* upon the plaine, and then placing the *Ea*
and *West* edge of the *Inſtrument* unto the ſide
the *Cube*, for then the obſeruation will be as t
former, and therefore, accommodated & concl
ded accordingly.

Pro. 48.

## *Fiftly, to finde whether an Alti tude be in the Point of libration or above, or below the levell of the eye, and how much.*

*Declaration.* *Let C B* and *X*, be three ſeverall obiects, a
let their ſeverall ſituations be required.

*Conſtructio.67.* *Firſt*, let the *Inſtrument* hang upon a reſt p
pendicular, and let it be held ſtedfaſt that
*Index* may be verticall, and play eaſily by the ſ
of the *Inſtrument*, then looking through the *ſig*
of it, lift the *Inſtrument* up and downe, untill y
ſee your marke, which ſuppoſe firſt *C*, and ad
the *Index* ſhould cut 5. in the line of *ſhadow*
which ſheweth that *C*, is higher then the eye
the 5th. part of the diſtance of the baſſis of
obiect, from the eye, ſuppoſed at *A*.

*Secondly*, if through the *ſights* of the *Inſtrum*
you ſee the ſecond obiect, *B* and the *Index* fall
upon no part in the line of *ſhadowes*, then it ſhe
eth that the point *B*, is levell with the eye, for
in any obſervation the *Index* fall betweene
beginning of the line of *ſhadowes*, (which is ne
the begining of *December*) and the ſight n

he eye, it argueth that the obiect is higher then
he eye, but if the *Index* fall beyond the beginning
of the line of ſhadowes, then the obiect is lower
hen the eye.

*Thirdly*, if you obſerve the obiect *X*, ( the
ye being at *A*,) then if in obſerving the *Marke* *Conſtru-*
*X*, through the *ſights* of the *Inſtrument*, the *Index* *ctio.*68.
hall fall beyond the beginning of the line of
*hadowes*, that is from the *Kalender* number
he degrees, in the *Limbe* from the edge of the
*ndex* unto that point, and account the ſame back-
vard from the point in the *Limbe* that is oppoſit
o the beginning of the line of *ſhadowes*, and lay
he edge of the *Index* unto it, then ſuppoſe the
*ndex*, in the line of *ſhadowes* interſect 8. which
heweth that the point *X* is lower then the levell
of the eye, by the eight part of the diſtance from
ou to the marke. Now if the diſtance ſhould be
oo. foote, then the point *X*, ſhall be below the
*orizontall* line, or line of levell *A B*, 12. foote
nd ½ which is the ⅛ part of 100. the diſtance be-
ore ſpecified.

## *Sixtly, how to finde the height of an Altitude above the levell of of the eye, either Acceſsible, or inacceſsible.*

*Pro.* 49.

*Let*, *B C* be an *Altitude* and the eye at, *A* di- *Declara-*
ant from the *Baſis* of *B*, 100. foote. *tio.*

*If* through the *ſights* of the *Inſtrument* the ſummet of the *Altitude B C*, viz. *C*, be ſeene, and the *Index* falling upon 5, in the line of *ſhadowes*, Conſtructio. 69. it argueth the *Altitude B C*, to be the 5 th. part of the diſtance, viz. of *A. B.* which is 20. foot. *Or* let the *Altitude* of *G*, be ſought out, whoſe *Baſis* cannot be ſeene Admit, the firſt ſtation be made at *A* and ſeing the ſummet of the *Altitude G*, the *Index* ſhould cut 3 in the line of *ſhadowes*, it Argueth that the diſtance to the *Baſis* of the *Altitude*, is triple to the *Altitude*, then if I ſhould go neerer to the *Altitude*, viz. at *D*, and ſhould obſerue the ſummet or top of the *Altitude G*, and that the *Index* ſhould fall upon 1. in the line of *ſhadowes*, then it ſheweth that the diſtance from *D*, to the *Baſis* of the *Altitude* is equall to the *Altitude*. Now ſuppoſe that betweene *D* and *A* were 80. foote it ſhould ſeeme that the *Altitude* obſerued ſhould be 40. foote, for if at *D*, the diſtance to the *Altitude* be equall to the *Altitude*, & the diſtance from *A*, to the *Altitude*, be *Triple* to the *Altitude*, then the diſtance from *D* to the *Altitude* is the $\frac{1}{3}$ of the diſtance *AR*, & ſo *AD*, ſhall be double to *DR*, therefore halfe the diſtance *AD*, viz. 40. foot is the *Altitude* required.

Por. 50.

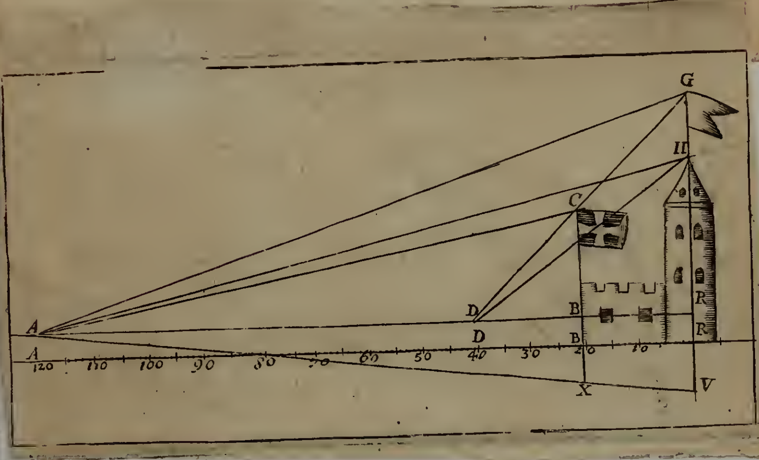
## *Seventhly, to meaſure any part of an Altitude which is not approachable.*

Declaratio. *Let G H*, a part of an *Altitude* be required to be meaſured.

*Firſt*, ſearch out the heigh[illegible], as before 40. foote, then admit ſtanding at *A* and looking to *H*, through the ſights, the *Index* ſhould cut 4, which ſhewes the diſtance from *A*, to be *Quadruple* to the *Altitude* of *H R*, and if comming neerer the *Altitude* 80. foote, viz. at *D*, *I* ſhould obſerve *H* againe, through the *ſights* of the *Inſtrument*, and finde the *Index* to cut 1, and $\frac{1}{3}$, in the line of the *ſhadowes*, then the diſtance from *D*, to the *Altitude H R*, viz. *D R*, ſhould containe the *Altitude H R*, once, and a third part of the *Altitude*, now ſeeing that *D R*, is 1 and $\frac{1}{3}$, therefore *H R* ſhall be 1, but the obſervation at *A* ſhewed the diſtance from *A*, to the *Altitude H R*, to be *Quadruple*, and ſeeing that *D R*, is 1, and 1 part of 3, therefore *A D*, muſt be 2, and 2 parts of 3, which makes *A R*, the whole diſtance to be 4, or *Quadruple* to *H R*, but if *A B*, 2, and 2 parts be 80. foote then *D R*, being 1, and 1, part ſhall be 40 foote, and if *D R*, 1, and $\frac{1}{3}$, be 40. foote, then *H R*, (which was 1 ſhould be but 30. foote, & ſo conſequently *H R*,) taken from *G R*, there ſhall remaine *G H*, 10. foote, the meaſure of the part of the *Altitude* required. In like manner might we applie the *Inſtrument* to the meaſuring of Bredths and diſtances: but that which is delivered may ſerve for the preſent, and as fully ſufficient for the ingenious.

*Conſtructio*. 70.

*Concluſion*,



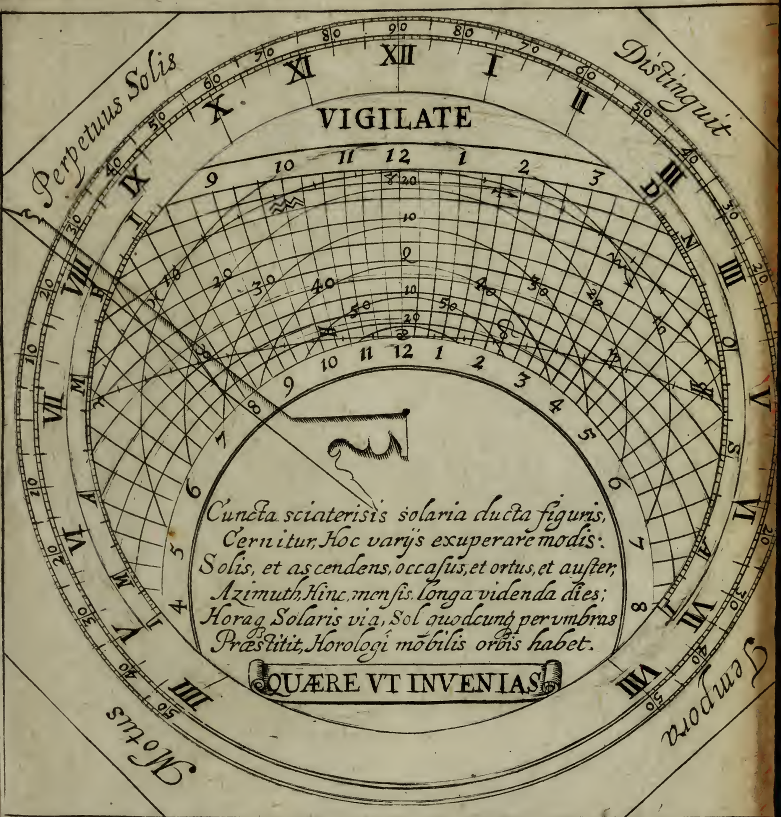
## *Concluſion.*

I might have Annexed unto this *Tractat* the demonſtration of this *Proiection*, which might have ſatisfied thoſe which are more learned, but to ſhew them it would be impertinent, ſeeing the thing lies ſo obuious: for others, it would not be reſpected or regarded, ſeeing the making, and practicall uſe of the *Inſtrument*, principally & Totally they looke after, which I have plentifully delivered. Now by way of Compariſon it is ſaid in the deſcription of *Maſter Gunters Quadrant*, that if a *Quadrant* were made ( as he there relateth ) unto a foote ſemidiameter, it ſhould ſhew the *Azimuth* unto a degree, & the houre unto a minute. It is moſt probable that if this *Horizontal Quadrant* have the ſame *ſemidiameter*, it ſhal ſhew the *houre* unto half a minut, and the *Azimuth* unto 3 m. And if in this *Tractat* I have beene too obſcure ( which I have avoyded as much as poſſible I could,) I intreat the *Reader* to excuſe me. I confeſſe I might more Methodically have digeſted it, and more aboundantly Amplified it, howſoever the affectionate I perſwade my ſelfe will not ſpurne at that which I have delivered; as for the Malevolent I way not: my few houres would not permit me to make a long premeditation of ſo great a facilitie. But if any one deſire to ſay more upon this *Horizontall Quadrant*, then I have done: I have made way for him, and vnuailed the ſubject, to helpe his ſight.

*From my houſe in Chancery-*
*Lane*, Ianuary, *Anno.* 1631.

*Deus donat & digerit.*

*FINIS.*



Cuncta sciaterisis solaria ducta figuris,
Cernitur, Hoc varijs exuperare modis:
Solis, et ascendens, occaſus, et ortus, et auſter,
Azimuth, Hinc, menſis, longa videnda dies;
Horaq Solaris via, Sol quodcunq per umbras
Præſtitit, Horologi mobilis orbis habet.

Anno Doñi 1637

Complete

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